New Junior Encyclopedia

Vol 15

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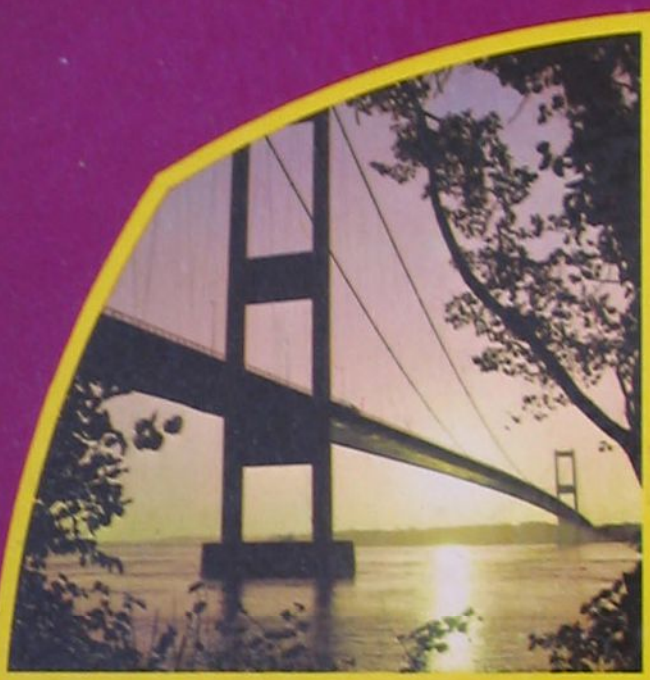

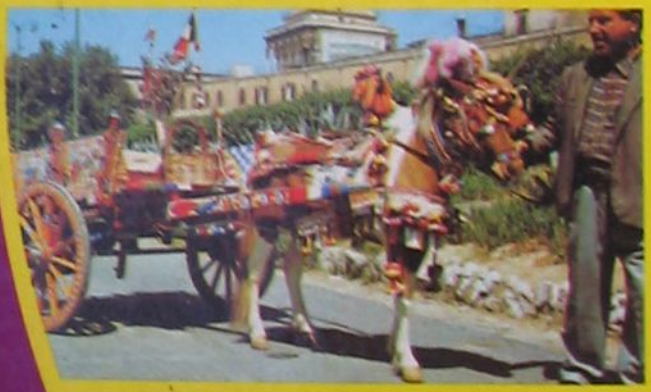

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Distributed in U.K. by arrangement with
City Magazines, 1-3 Wine Office Court, Fleet Street, London.
Distributed in Australia and New Zealand by
Bay Books (Pty) Ltd, Sydney.
Made and printed in Great Britain by
Purnell & Sons Ltd, Paulton.

On the *Winston Churchill* sailing ship boys learn the centuries-old skills of handling a sailing vessel.

Seasons are general divisions of the year marked by differences in the temperature and weather, and in plant and animal life. In the temperate zones of the Earth, there are four seasons—spring, summer, autumn and winter. Spring is the time when plants burst into life after the cold winter, and many animals are born. Summer is the warmest season. In autumn, many plants and animals die.

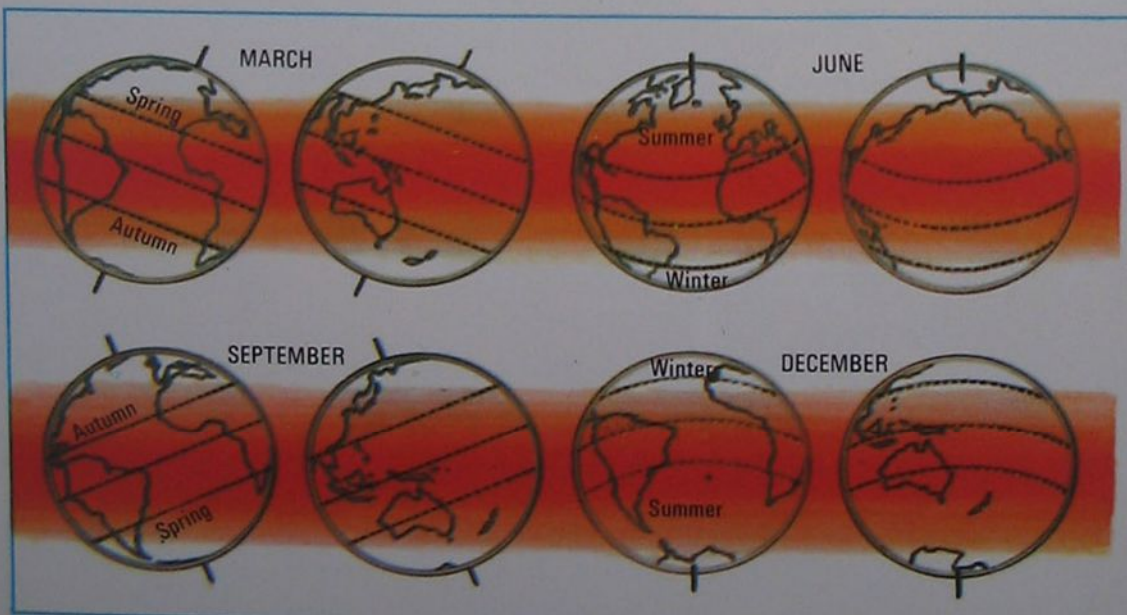
The official dates marking these seasons are the *solstices* (the days when the Sun is highest or lowest in the sky at noon) and the *equinoxes* (the days, twice a year, when the Sun is directly above the Equator and the periods of light and darkness are of equal length all over the world). In the northern hemisphere, spring begins officially on March 22, summer on June 22, autumn on September 23, and winter on December 22. But many people consider that the seasons start a little earlier than these dates.

The apparent movement of the Sun up and down in the sky over the year, and the changing seasons, are caused by the movement of the Earth around the Sun. The Earth's axis is tilted at an angle of 23½ degrees to a line perpendicular to its orbit around the Sun. Consequently, as the Earth travels round the Sun, first one Pole and then the other leans towards the Sun. When the North Pole tilts towards the Sun, northern lands have their summer. At the same time, the South Pole leans away from the Sun, and southern lands have their winter.

Six months later, the Earth has travelled to the other side of the Sun. Now the North Pole leans away from the Sun and the South Pole leans towards it. Northern lands have their winter and southern lands have their summer. The days are longer in summer and, as the Sun is higher in the sky, it gives more warmth.

The tilting of the Earth has less effect in the tropics, where the Sun is always high in the sky and the four seasons do not occur. Instead, the year is divided into rainy seasons and dry seasons.

SEATO is a short name formed from the initial letters of the South-East Asia Treaty Organization. This is a group of nations organized to form a collective defence pact against communist aggression in South-East Asia. It was initiated by the United States in 1954, and besides the U.S. it consists of Australia, France, New Zealand, Pakistan, the Philippines, Thailand, and the United Kingdom. The organization has turned out to be largely ineffective because three of the most important nations in that part of the world, namely, Japan, India, and Indonesia, refused to join. Some member nations, such as France, Britain and Pakistan, have refused



The Earth travels round the Sun tilted at an angle of 23½° from a line perpendicular to its path round the Sun. These diagrams show the tilt of the Earth's axis as seen from the sun during the various seasons.

to send troops to help the United States fight in Vietnam, or have withdrawn their armies from the alliance altogether.

Seeds are the 'survival packs' of flowering plants. They are the means by which typical flowering plants reproduce their kind and hand on characteristics to their offspring.

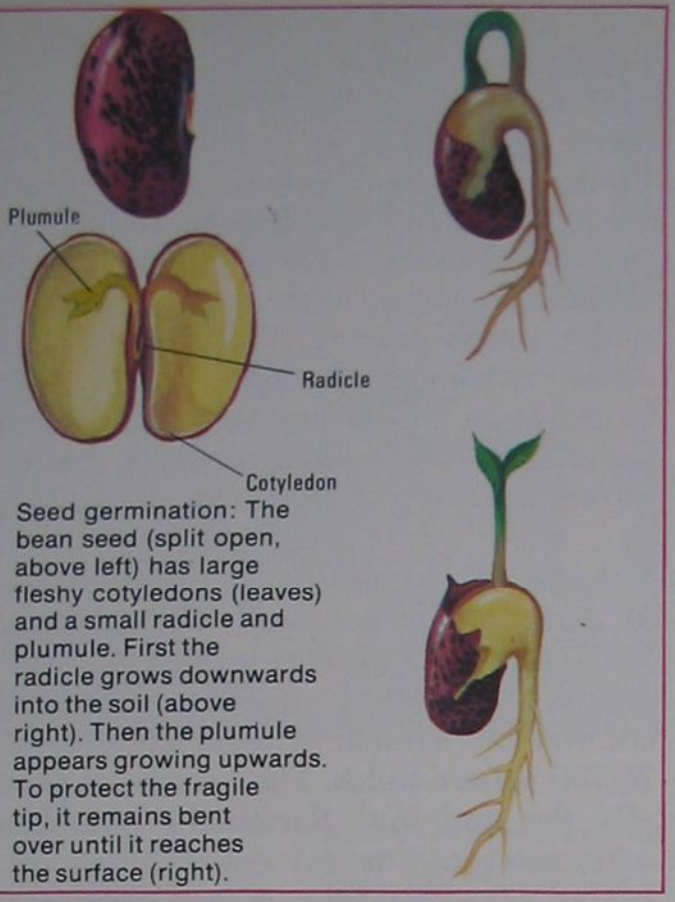
Seeds develop from ovules, which are contained in *carpels*—the female apparatus of the flower (see Flower). A flower may have one or many carpels, depending on the species, and each carpel may house one or many ovules. So, a flower's range of seed-production stretches from one to many. Flowers of fruit trees such as almonds, cherries and plums have a single carpel that contains a single seed. Buttercups have many carpels but each contains only one seed. Legume flowers such as those of peas and beans, on the other hand, have a single carpel, but this contains several seeds. At the other end of the scale are plants such as poppies which produce enormous numbers of seeds from a single flower.

Plant seed vary enormously in size as well as in number. Orchid seeds and those of foxgloves and tobacco plants are so tiny they look like dust. Yet those of the double coconut of the Seychelles Islands in the Indian Ocean are enormous and weigh up to 40 pounds.

An ovule sits snugly inside the protective carpel attached at one point to the carpel's inner wall. The ovule itself is protected by two layers of cells called *integuments*.

A pollen tube from a suitable pollen grain grows into the carpel and forces its way into the embryo sac through a small hole in the wall of the ovule called a *micropyle*. Here, the end of the tube bursts, and two male nuclei enter the embryo sac. One of these fuses with a female egg cell which at once begins

Defence forces from many countries make up the forces of SEATO, an alliance formed to combat communist aggression in South-East Asia.

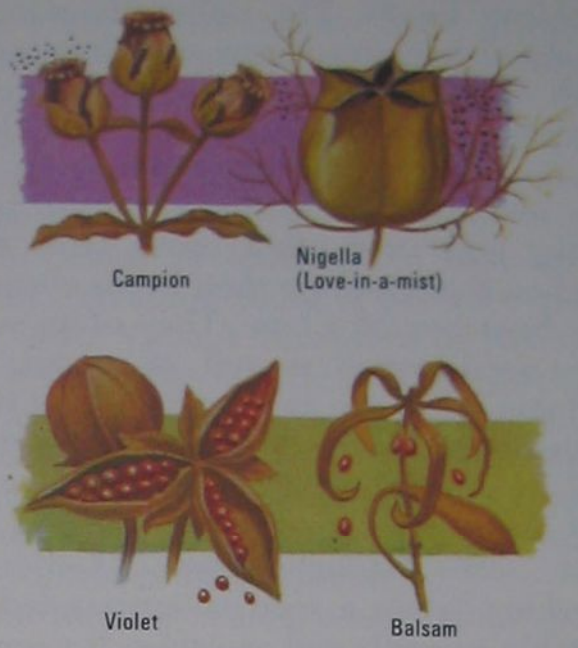


Seed germination: The bean seed (split open, above left) has large fleshy cotyledons (leaves) and a small radicle and plumule. First the radicle grows downwards into the soil (above right). Then the plumule appears growing upwards. To protect the fragile tip, it remains bent over until it reaches the surface (right).

to develop into a tiny embryo plant. The embryo consists of a rudimentary stem, root, and leaves. Meanwhile, the other male nucleus fuses with two female nuclei called polar bodies. These give rise to an *endosperm* which will nourish the young plant in its first few days of life. Some plant seeds do not have an endosperm. The embryo leaves absorb all the food and take on the job of nourishing the seedling plant themselves.

The integuments of the ovule become tough and the seed begins to lose water. Eventually the fully ripe seed breaks away from the inner carpel wall. The carpel itself has developed meanwhile into a *fruit*, which protects, and often helps to scatter, the ripened seeds.

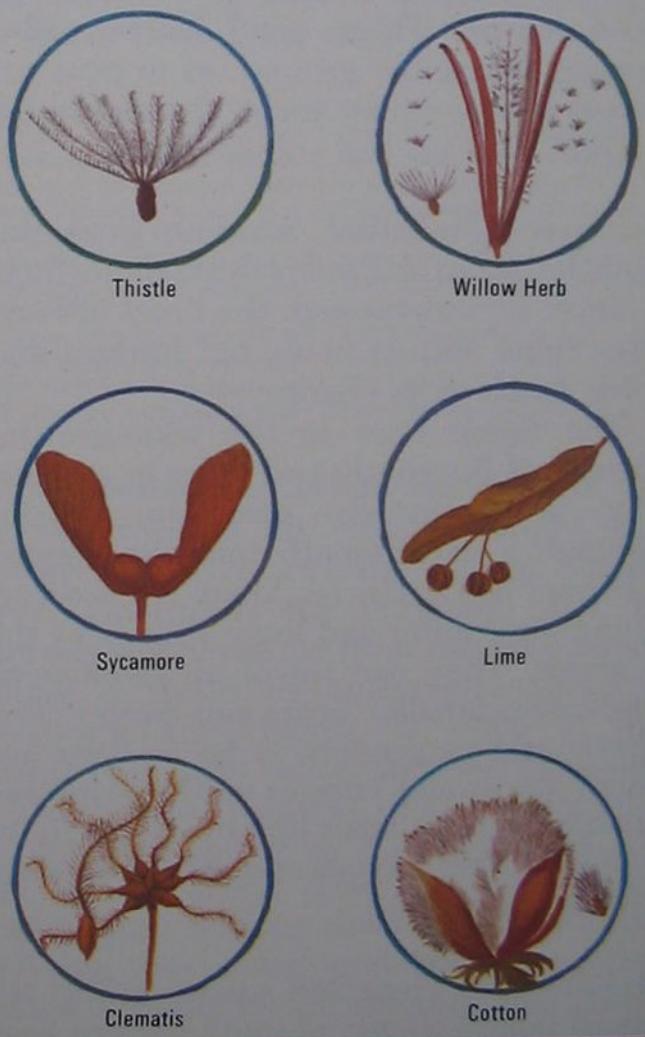
The mark of many successful plants is an effective method of seed distribution. Orchid seeds are so light they float on the wind. Many kinds of seeds are housed in winged or plumed fruits that remain airborne long enough to carry the seed well away from its parent. Common examples of winged fruits include those of clematis and thistles. The seeds



Top: Some seeds are dispersed by the censer mechanism. The seeds are shaken out of the capsules by the wind.

Above: Some seeds are dispersed mechanically by explosive or twisting movements of fruits.

Below: Examples of wind-dispersed fruits and seeds.



of some other plants are scattered when the fruit bursts. The ripe pods of many kinds of legumes throw out their seeds with explosive force. Many fleshy fruits are attractive to animals, who carry them off to eat. In so doing, they carry off the seeds as well. Mistletoe berries have sticky juice and often cause birds that feed on them to wipe their beaks clean on the branches of a tree. They often wipe off a seed or two as well, of course.

Some seeds can survive for a long time in unfavourable conditions. But few kinds will be much use after 10 years or so, and seeds such as those of parsnips are best sown straight away. Generally speaking, when a seed is surrounded by suitable warmth and moisture it *germinates*. It absorbs a lot of water and bursts out of its coat. The embryo root emerges first and plunges down into the soil. The young shoot then appears and grows up to break the soil surface. Shoot and root are fed by the endosperm or by the seed leaves. These seed leaves either remain below the ground, as in peas and broad beans, or, far more commonly, are carried aloft on the young shoot.

Seine is a beautiful, winding river that flows for about 482 miles through northern France. It runs through the heart of Paris. The Seine and its many old bridges give Paris much of its charm.

The Seine rises in the wine-growing district of Burgundy and flows in a generally north-westerly direction, passing through a wide mouth into the English Channel at Le Havre. Many large ocean-going ships enter and leave France by this harbour. They can travel up river as far as Rouen. Smaller boats and barges carry goods and passengers as far as Paris and other towns and villages on the Seine and its tributaries. Canals link the Seine to the Rhône, Rhine, Meuse and other important rivers in Europe.

Selkirkshire (area 268 square miles) is a small inland county of south-eastern Scotland. Its county town is Selkirk, and its population is 20,900.

The county is hilly, reaching its highest point at Broad Law (2,754 feet) on the border with Peeblesshire in the south-west. The main rivers are the Tweed, Yarrow and Ettrick. Sheep breeding is the chief occupation, with most of the land under rough grazing. There is also some cattle rearing and dairy farming. The largest town is Galashiels, where the manufacture of woollens (especially hosiery, tartans and tweed) is the main industry.

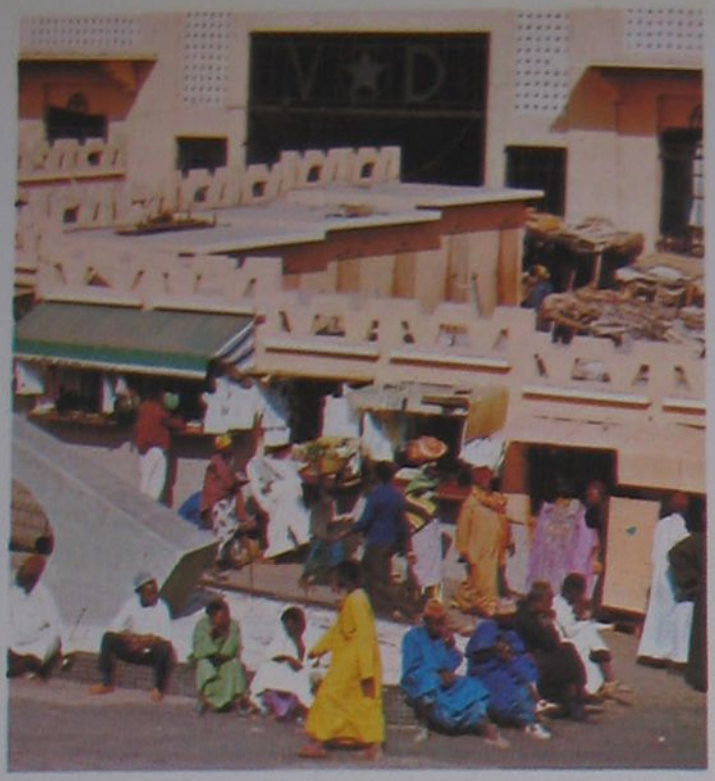
Senegal is a republic on the west coast of Africa. It is bounded by Mauritania, Mali, Guinea and Portuguese Guinea. It almost completely surrounds the tiny country of Gambia. Senegal has an area of 75,750 square miles. The country is generally flat and low. Savannahs (grasslands with scattered trees) cover much of it. Inland, the weather is hot. Along the coast it is milder.

About 4,000,000 people live in Senegal. They belong to a number of African tribes, including the Wolof, Fulani and Serer tribes. The majority of people are Muslims. Less than a quarter of the population live in the cities. Dakar, an Atlantic seaport, is the capital and largest city.

Most of Senegal's people are farmers or herders. They grow rice, millet, sorghum, cotton and peanuts. They export some of these crops, as well as tinned fish and phosphates.

The French made Senegal a territory of French West Africa in the late 1800's. The country gained independence in 1958.

Senses are the means by which we and other creatures learn about our surroundings and about our bodies themselves. We have five main external senses: sight, hearing, smell, taste and touch. There are *sense organs* or *receptors* corresponding to each sense. Receptors are nerve endings that start nerve signals when they detect certain changes in the surroundings. The nerve signals



Above: The Sandaga market is in Dakar, the capital of Senegal. The colourful clothes of the shoppers and the interesting architecture are typical of Senegal.

Left: The location map shows the position of Senegal on the Atlantic coast of Africa.

travel to the brain, which interprets them as, perhaps, a smell, taste, or sound – depending on which receptors caused the signals.

In Man, the most sensitive and accurate sense is sight. The sight receptors are special nerve endings called *rods* and *cones* in the retinas of our eyes (see Eye). They are *stimulated* (made to produce nerve signals) by light. Our ears, the sense organs for hearing, are stimulated by the vibrations in the air we call sound. The receptors which produce nerve signals are attached to tiny hairs in the inner ear (see Ear).

Smell and taste are called the *chemical senses*, because their receptors detect chemical substances in the air or in our food. The receptors for taste are tiny *taste buds* on the tongue. There are four main kinds of these: one each for sweet, salty, sour, and bitter tastes. But the flavour of a food is really its smell. This is detected by nerve endings at the back of the nose.

The sense of touch is, in fact, many senses, including those of pressure, pain, and heat. Various receptors in the skin are responsible for these. The most important are simply free nerve endings, which are the pain receptors. Many things stimulate them – including great pressure, strong chemicals, pin-pricks, and extremes of temperature.

Our internal senses, which tell us about our body, are extremely important. The *muscle sense*, for example, tells us the positions of our limbs without our having to look at them. Other internal senses include those of hunger and thirst, balance and weariness. There are also pain receptors inside the body, though far fewer than in the skin.

Talking points

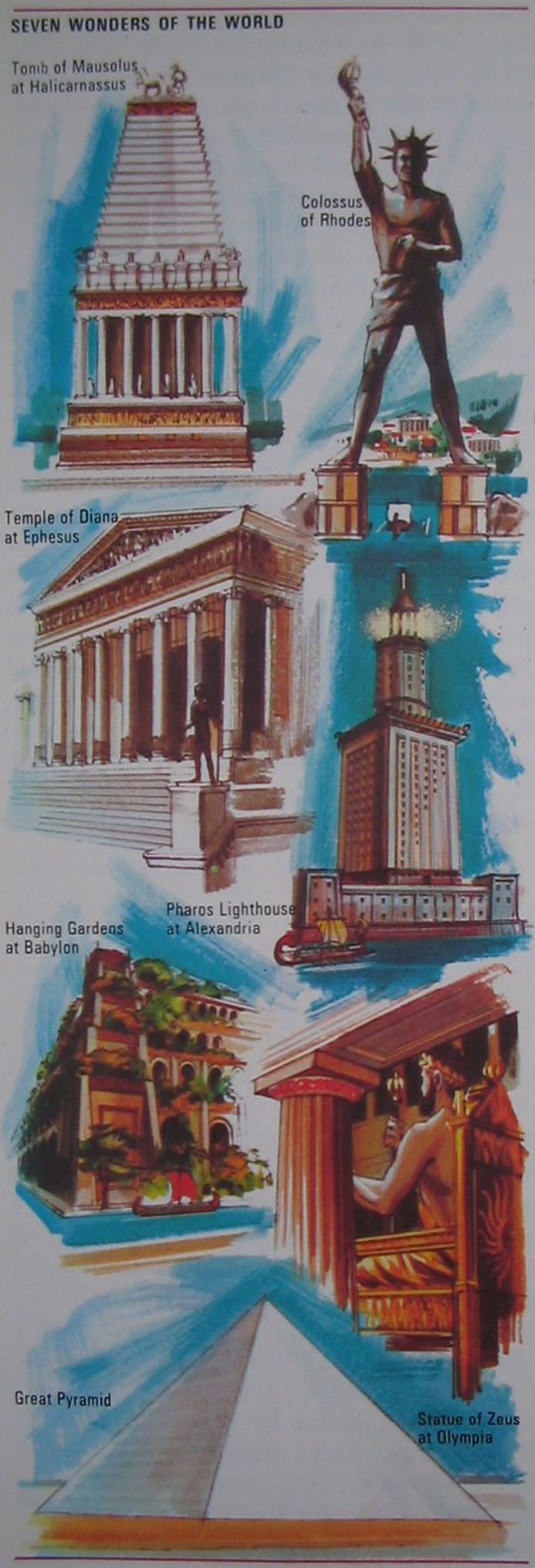
* If a person loses the use of one of his senses (for example if he becomes deaf) then his other senses may become more acute to compensate for the loss. What instances of this can you think of?
* Some people are said to have a sixth sense, meaning that they have premonitions of dangerous situations that are about to happen. Do you think that the sixth sense exists? If so, have you had any experience of it yourself?
* Discuss which of Man's five senses is most important to his survival. Would a man's most important sense be the same as a dog's?

Articles to read

Anaesthetics; Brain; Deaf and dumb language; Ear; Eye; Nervous system.

Servomechanisms When the pilot of an aircraft reaches his cruising height and speed and is on course, 'George' takes over. 'George' is the automatic pilot. If there is any deviation from the set course, height, or speed, the auto-pilot makes the necessary adjustments. It does so by means of devices called *servomechanisms*.

This is what happens when the aircraft is blown off course by a gust of wind. As the aircraft strays from the set course, the compass reading alters. The difference between the actual and pre-set course causes a signal in the servo-system. This


SEVEN WONDERS OF THE WORLD
Tomb of Mausolus at Halicarnassus
Colossus of Rhodes
Temple of Diana at Ephesus
Pharos Lighthouse at Alexandria
Hanging Gardens at Babylon
Great Pyramid
Statue of Zeus at Olympia

signal is *amplified* (strengthened) so that it can operate a power unit which adjusts the aircraft's controls. All this happens very quickly.

This is an example of a servomechanism that controls itself. It acts on a difference between what *is* and what *should be* happening. Ships are steered and guided missiles kept on course by similar systems. Servomechanisms are widely used in industry in all kinds of automatic control systems. (See Automation.)

Not all servo-systems are self-controling, however. Some are merely devices to amplify a force or a signal. This is usually called *servo-assistance*. Familiar examples of such systems can be found in powerful automobiles. Braking such vehicles is hard work using manpower alone. They therefore have servo-assisted brakes. A weak pressure exerted by the driver is increased by the system into a strong pressure to apply the brakes. Automobiles may have servo-assisted steering, too.

Seven Wonders of the World After the death of Alexander the Great, the Greeks became great sightseers. They made a list of the seven great sights of the ancient world, and this has come down to us as the *Seven Wonders of the World*. These were:

1. The *Pyramids*, or tombs of the Pharaohs in Egypt, the greatest of which is to be found at Giza near the Upper Nile.

2. The *Hanging Gardens of Babylon*, probably gardens planted on the sides, or terraces, of the great Babylonian temple-towers, called *zigurrats*.

3. The magnificent *Temple of Diana*, outside the city of Ephesus in Greece. This was huge, with 127 carved columns, some of which are now in the British Museum.

4. The great *Statue of the God Zeus*, at Olympia, made by the famous sculptor, Phidias, around the year 325 B.C. It was made of gold and ivory.

5. The *Tomb at Halicarnassus*. This

was the tomb of Mausolus (from whom we get our word *mausoleum*), who was the ruler of Caria in Asia Minor. The tomb was erected at Halicarnassus by his widow.

6. The *Colossus of Rhodes*, which was a great bronze statue of the sun-god Helios, made in 250 B.C. It stood at the entrance to the harbour of the Island of Rhodes, reaching a height of 100 feet.

7. The final wonder of the ancients was the first lighthouse of its kind, known as the *Pharos of Alexandria*. It stood on the island of Pharos, at the entrance to Alexandria Harbour, around 300 B.C., and towered to a height of 400 feet.

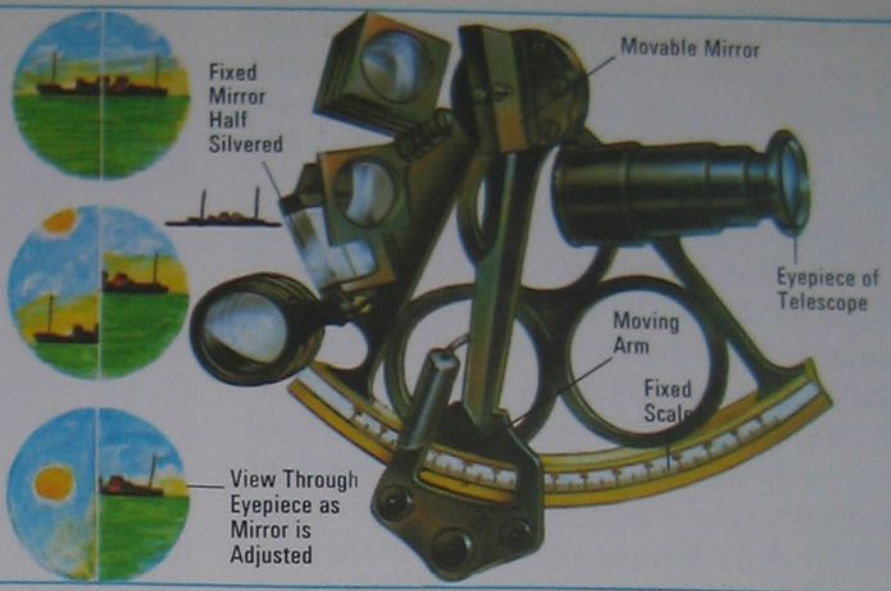
Severn This is the longest river in Britain. It rises in west-central Wales and flows for 210 miles along a semi-circular course to empty into the Bristol Channel. With its main tributaries, it drains an area of 4,350 square miles.

At certain high tides in the year, the waters of the Bristol Channel roll back the waters of the Severn to form a spectacular *bore* (tidal wave) that sometimes reaches a height of 6 feet. The Severn Road Bridge, linking London with South Wales, was opened in 1966. With a main span of 3,240 feet, it is one of the longest suspension bridges in the world.

Seville, the leading city of the Andalusia region of southern Spain, is a well-known tourist attraction. Many of its old buildings and streets reflect centuries of Moorish influence and paintings by Spain's greatest masters can be seen. An inland port on the River Guadalquivir, Seville exports wine, olive oil, oranges, cork and other products of the surrounding countryside, as well as cotton textiles, pottery, chemicals and other manufactured goods. The city's population is 650,000.

Sewage disposal A vast amount of sewage —waste matter and dirty water—comes from a modern town. Disposal of it presents quite a problem. It cannot just

The road bridge across the Severn is the seventh longest suspension bridge in the world, with a main span of 3,240 feet. It was opened in 1966 as a direct link between London and South Wales.



Using a sextant. A movable mirror is adjusted until the reflection of a particular celestial body appears alongside the horizon when viewed through the eyepiece. A fixed scale on the sextant then indicates its angle of elevation.

be pumped into the fields and left because it contains germs that would find their way into the rivers and lakes from which we draw our drinking water, and disease would result. This is what often happened in the past, and outbreaks of cholera and typhoid were only too common.

Today, sewage is treated at sewage 'farms' to make it harmless. Extensive networks of pipes called *sewers* carry the sewage to the farms. There, it first goes through *screens*, or sieves, which remove solids such as paper and sticks. Then it flows into *settling tanks*. The particles suspended in the water settle out as a liquid *sludge*.

The water remaining is then generally sprayed onto porous *filter beds* through revolving sprinklers. Sometimes it is passed into tanks and air is blown through it. In both methods small organisms such as bacteria break down the impurities in the water into harmless products.

The sludge is usually treated in *digestion tanks* where it ferments and gives off the gas methane. The black material that remains is a valuable fertilizer.

Many water sewers were once rivers that have now been roofed in or diverted into tunnels to make way for building work. London has many underground rivers. A large cast iron pipe that crosses over the platforms and tracks at Sloane Square Underground station carries the Westbourne—the river that flows through the serpentine in Hyde Park.

Sextant This is an instrument used in navigation. By sighting several stars through the sextant, the navigator on board a ship can calculate his position on the Earth's surface.

Fixed to the frame of a sextant are a telescope, two mirrors, and a movable arm fixed at one end and moving along a graduated scale in a circular arc. The scale measures 60 degrees. One mirror, the *horizon glass*, consists half of a mirror and half of plain glass. It is fixed, whereas the other mirror, the *index glass*, is a whole mirror attached to the movable arm.

The navigator holds the sextant with the frame vertical, and looks through the telescope and plain glass of the horizon mirror at the horizon. The movable arm, called the *index arm*, is moved and an image of a certain star is reflected from the index glass to the horizon glass and then into the telescope. When the image of the star appears to touch the horizon in the telescope, the navigator reads the angle indicated by the position of the index arm on the scale. This gives him the angle between the star and the horizon, or its *altitude*. By measuring the altitude and *bearing* (direction) of several stars, and by noting the exact time of the observations, the navigator can calculate the position of the ship from special tables. Aircraft navigators use a special sextant containing an artificial horizon.

John Hadley in Britain and Thomas Godfrey in the United States invented the sextant in 1731.

Seychelles are a group of 89 islands in the Indian Ocean, lying 700 miles northeast of Madagascar. They are a British Crown colony. Altogether, the islands have a land area of about 156 square miles. The two most important islands are Mahe (on which is Victoria, the capital) and Praslin. Both islands are mountainous and volcanic. The tropical forests that once covered them have been cleared to make room for vanilla and cinnamon plantations. Islanders produce perfume oil and coconut products. Many of them are fishermen. Most of the 51,000 people speak a variety of the French language known as *Creole,* although English is the official language.

Vasco da Gama, the Portuguese navigator, discovered the Seychelles in 1502, but France claimed the islands in the mid-1700's. Britain captured them in 1794 and administered them as part of Mauritius until they became a separate colony in 1903.

Shaftesbury, Anthony Ashley Cooper, 7th Earl of (1801-1885), was a deeply *philanthropic* (charitable and benevolent) statesman who helped to bring about many much needed reforms in Victorian Britain. He entered the House of Commons in 1826 as Member of Parliament for Woodstock. In 1834 he was made a Lord of the Admiralty and in 1851 inherited the earldom.

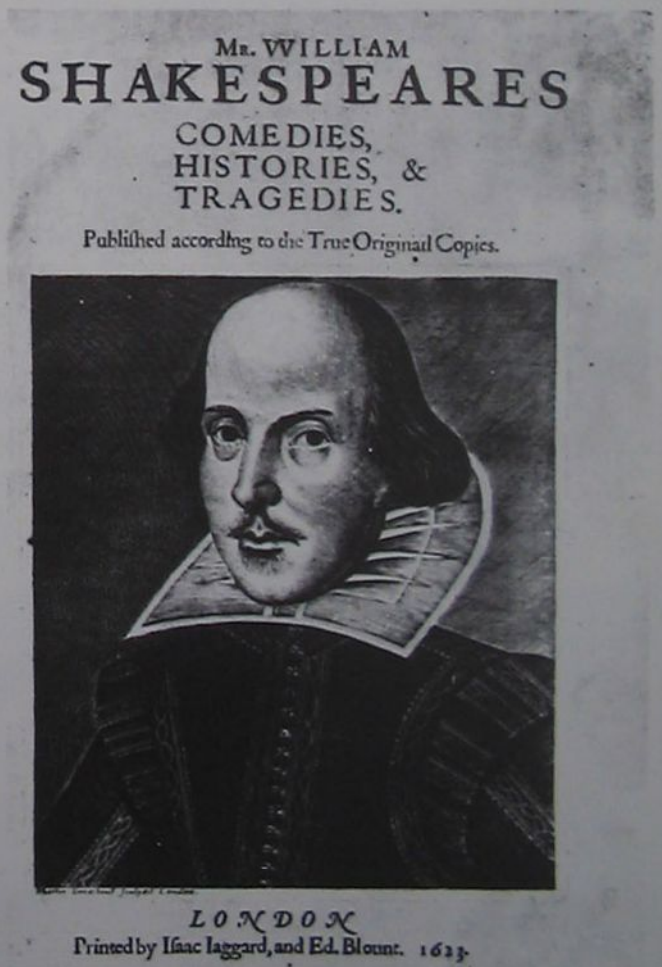
In 1829 he helped to improve the law relating to lunatics. In 1833 he was actively concerned with the welfare of mill and factory workers, and later was mainly responsible for an act—the Ten Hours' Act of 1847—that improved their working conditions still more. The Mines Act (1842) was put through Parliament largely by his efforts. This act prohibited the employment of women and children underground.

Among other reforms with which he was associated were the establishment of the Ragged Schools for the poor, the abolition of child chimney sweeps, and more enlightened treatment for young offenders.

Shakespeare, William (1564-1616), the English poet and playwright, is one of the very few writers to be famous throughout the world, and is generally considered to be the greatest of all dramatists.

We know very few definite facts about Shakespeare's life, and there are many legends about him. He was born at Stratford-on-Avon, where his father was a prosperous glovemaker and trader. During Shakespeare's childhood his father lost money, but was never really poor. William was probably educated at the free grammar school in Stratford. In 1582 he married Anne Hathaway. His elder daughter Susanna was born in 1583, and his

The frontispiece of the collection of Shakespeare's plays printed in 1623 and now known as the First Folio.



twins Hamnet and Judith two years later.

In 1585 Shakespeare left Stratford, and we have no definite knowledge about the next few years. At some point he arrived in London, and was probably connected with one of the two London theatres of the time. Later he joined the Lord Chamberlain's company of players, who were to become the most prosperous theatrical group in London. By 1592 Shakespeare was already both an actor and a playwright. The order and dates of his plays are uncertain, but it is probable that *Henry VI*, dating from 1591, was his earliest play.

In 1593 and 1594 *Venus and Adonis* and *The Rape of Lucrece* were published, two narrative poems dedicated to the Earl of Southampton. They were immediately popular. At about the same time the sonnets appeared, some addressed to a young man and some to a mysterious dark lady. He wrote several comedies during this period, and *Romeo and Juliet*, his first tragedy.

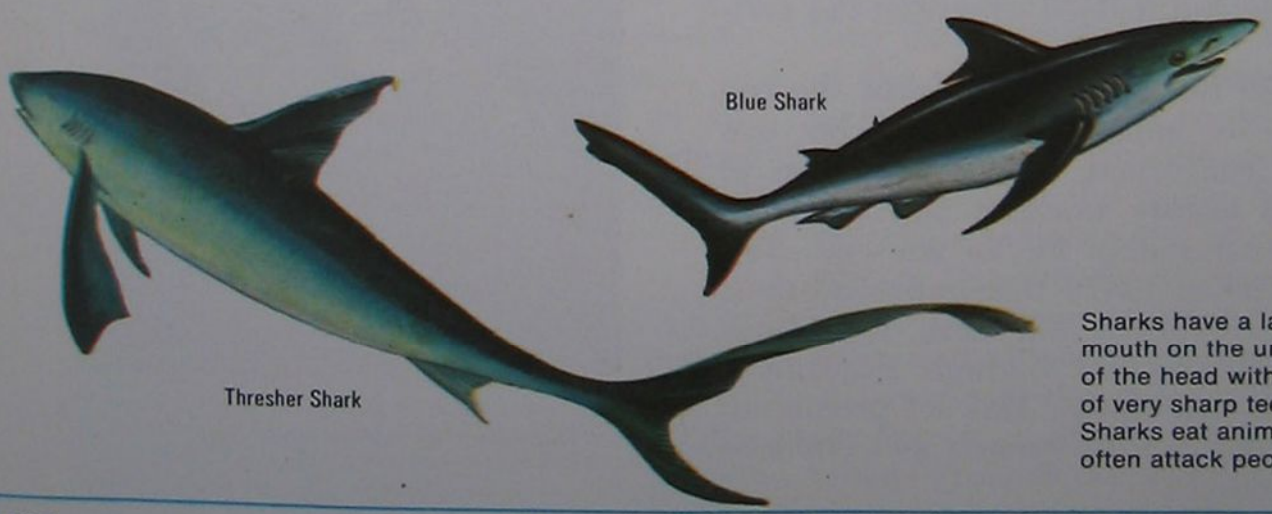
By this time Shakespeare was financially very successful. In 1597 he bought New Place, one of the largest houses in Stratford. In 1599 the Chamberlain's Men acquired the new Globe theatre and Shakespeare produced *Julius Caesar*. After the succession of James I, who greatly admired Shakespeare, most of the great tragedies, *Hamlet*, *Othello*, *King Lear* and *Macbeth*, were written. *The Tempest* was probably the last play he completed. His final years were spent mainly at Stratford.

His plays were first collected in one edition in 1623 and published in the 'First Folio'. Shakespeare was a popular playwright in his day, and his fame has increased and spread ever since.

Shanghai is a city and seaport in the province of Kiangsu, China. It is well placed on the Whangpoo River in the Yangtze delta. It is the largest city and also the chief trading port of the country, with exports of rice, paper, cotton and wool. Of major importance is its very large foreign transit trade. The city has large manufactures with cotton spinning and weaving factories, machine building plants and chemical works. Old slums still exist but much of the city is now modern. Its population is over seven million.

Sharks are the most feared of fishes, although many of them are harmless to Man. But they have a fearsome appearance, with their wedge-shaped heads and rows of sharp teeth. Their long, slender bodies have a triangular *dorsal* (back) fin, which often sticks out of the water, and large tails.

Sharks vary in size from one foot up to 45 feet. The rare whale shark is the largest shark and the world's largest fish, but it is harmless to man. Man-eating sharks include the white shark, leopard shark, tiger shark, and blue shark. They



Sharks have a large mouth on the underside of the head with rows of very sharp teeth. Sharks eat animals and often attack people.

live mostly in tropical seas but sometimes venture into temperate waters.

The strangest looking shark is the hammerhead shark. The head is hammer-shaped, having two outgrowths on the ends of which are the eyes. The dogfish is a small shark two to three feet long. Dogfish are common fish and are caught for food. They are sold as 'rock salmon' or 'flake'.

Sharks differ from most other fishes in that their skeletons are made of cartilage and not bone. Other cartilaginous fishes include the skates and rays. These are large fishes with diamond-shaped, flat bodies and long tails. Skates grow to a length of one to four feet, and are caught for food. Rays are slightly larger. Some are armed with poisonous spines, and one species, the electric ray, produces electric shocks to stun its prey.

Sheep are important farm animals from which we get meat, wool and milk. People have kept flocks of sheep for several thousands of years, spinning their wool into cloth, eating their meat, drinking their milk, and wearing their skins. We also get a kind of leather from the skins, and sheep provide raw materials for making soap, glue, fertilizer, and several other products. The gut used to string musical instruments and tennis rackets comes from sheep.

A male sheep is called a *ram*, and a female a *ewe*. Sheep are medium-sized animals, the rams weighing up to 350 pounds. Sheep resemble goats in their basic shape and they are members of the same family of animals, called the *Bovidae*. But goats do not possess the great woollen coats of domestic sheep, and sheep do not have the beard of the billy goat.

Wild sheep have large horns, and do not have thick coats of wool. They look much more like goats than domestic sheep, and behave more like goats. Most kinds of

Droving a flock of 4,200 sheep on a sheep station in New South Wales, Australia. These are Merino sheep that have recently been sheared of their heavy coats.

wild sheep live in the mountains and high regions of Asia, braving precipitous slopes and extreme cold. The argali sheep of the Altai Mountains of Russia and Mongolia is four feet high and has long spiral horns.

Domestic sheep are descended from wild sheep of southern Asia and southern Europe. Sheep are bred mainly for their wool or for their meat (mutton or lamb), but some produce both meat and wool of good quality. Merino sheep are reared for their fine wool. Many breeds are named after parts of England, such as Lincoln, Leicester, Dorset Horn and Suffolk sheep. There has been much cross-breeding aimed at improving wool yields and meat quality.

Sheep are easy animals to keep. They herd together and can be let loose to graze on large areas of pasture land. The shepherd and his dog can round them up when the time comes. On the sheep stations of Australia and New Zealand, there may be flocks of thousands of sheep.

The world's leading sheep-rearing countries are Australia and Russia. But sheep are very important in New Zealand, where there are about 20 sheep for every human being.

Shelley, Percy Bysshe (1792-1822) was one of the greatest of English poets, although hardly known in his day. His style was deeply personal, imaginative and rebellious. He had a deep love of humanity.

In 1811 he was expelled from Oxford University for publishing a pamphlet that explained his disbelief in God. That year he married 16-year-old Harriet Westbrook, but they soon parted, and later Harriet drowned herself. Shelley then married Mary Godwin, whose father, a philosopher, he greatly admired. In 1818 Shelley left England permanently, to live in Italy. Four years later he was drowned in a storm at sea.

Among his masterpieces are 'Prometheus Unbound' (1818), 'Ode to the West Wind' (1819), and 'To a Skylark' (1820).

Shells are the hard outer coverings of certain animal bodies, and of some eggs and seeds. The shell protects the delicate parts of the animal or plant within it. The shells that enclose bird and reptile eggs break open when the young animals hatch. Similarly, the shells of such seeds

Sea shells are the outer covers of shellfish. The hard shells are left, after the soft bodies of the shellfish have rotted away. Shells are often washed up on beaches.

Shellfish are bred for eating. They are grown on the sea bed. Above: Oysters are prepared on an oyster farm.

as walnuts and peanuts break open when the seeds begin to germinate. Some animals retain protective shells throughout their life. They include turtles and tortoises; beetles and certain other insects; *crustaceans* such as lobsters, crabs and shrimps; and about 100,000 different kinds of *molluscs*.

Mollusc shells are the most common. They include most of the sea shells people pick up on beaches. They have a wide variety of shapes and colours. They are interesting to study and collect. Sometimes people use sea shells to make jewellery or to decorate household objects. At one time people used shells for trading as a form of money.

There are two main kinds of mollusc shells. The *univalves* or *gastropods* have a single shell. Snails, whelks and winkles belong to this group. Their shells are coiled. Limpets are also univalves. But their shells are cone-shaped. Cowrie shells are curved inward.

The *bivalves* have a pair of matching shells held together by a hinge of muscle. They include mussels, oysters, cockles and clams. A third, and smaller group is that of the *tooth shells*. They are long and pointed, shaped like a sharp tooth or tusk.

Most mollusc shells are found in or near the sea. But some kinds of mussels and clams live in fresh water, and many snails live in earth or on trees. Mollusc shells range in size from those of minute snails, about as big as a grain of sand, to those of giant clams and conches.

Mollusc shells are formed of calcium carbonate, a hard mineral substance. Usually they consist of three different layers. The outer layer is tough and solid. The middle layer has a crystalline formation. The inner layer is usually smooth and shiny. It forms the iridescent substance called *mother-of-pearl* or *nacre*.

Ships A prehistoric man, struggling against a fierce current in a river, clawed desperately at a floating log and somehow managed to save himself from drowning. This may have been how the long history of ships began. Man found that he could travel easily across water on a log. At first he sat astride the log and guided and propelled it with his hands. Then he hollowed it out and sat inside it. This *dug-out canoe* was the first form of ship.

Now, thousands of years later, sleek ocean liners a thousand feet long can cross the Atlantic Ocean in under four days. Such liners as the *France*, *United States*, and *Queen Elizabeth II* rival the most exclusive hotels in luxury. But even bigger are the super-tankers with a capacity for millions of gallons of oil. Such vessels are a far cry from the dug-out canoe of prehistory.

Other materials besides tree trunks were used for making early boats. The Ancient Egyptians at first built boats by lashing reeds together. The Ancient Britons fashioned little circular craft called *coracles* by stretching animal skins over a wickerwork frame. A few fishermen use coracles in Wales even today.

Early Man found that propelling his crude boat with paddles or pivoted oars was hard work. Then, probably by accident, he discovered that he could harness the wind to push the boat along if he rigged up a square of cloth or matting on a pole, or mast. This discovery of the *sail* enabled Man eventually to build

S.S. *France*, one of the finest passenger liners in the world, moves slowly past New York's skyscrapers.

bigger and heavier boats and to venture across the sea to distant shores.

But for a great many years, oars were the main source of power, with a single sail to help if the wind was in the right direction. By 3000 B.C. the Egyptians were travelling over the sea to Crete in slender, many-oared ships with a single, central sail. These ships were called galleys. The oarsmen were usually slaves.

Later, the Phoenicians, the Greeks and the Romans developed the galley into a powerful fighting ship. Their galleys had two, three, and sometimes more *banks* (rows) of oars, and a projecting ram in the bows (front). The two-banked vessel was called a *bireme*, the three-banked a *trireme*. The combination of oars and sail continued up until about the 1500's. One of the best fast fighting vessels of this kind was the Viking longship, which had only one bank of oars.

In about A.D. 1000, a new kind of sail appeared called the *lateen* sail. It was triangular and enabled boats to sail into the wind as well as with the wind. This led by the 1400's to the development of the classic *full-rigged* ship, with a mainmast and foremast with square sails and a mizzen mast at the rear with a lateen sail. The square sails were split into two—a main sail and a top sail—for greater flexibility.

The arrangement was used in Christopher Columbus's tiny ships, *Santa Maria*, *Pinta* and *Nina*, in which he sailed to America (1492), and in the larger armed galleons, such as Francis Drake's *Golden Hind* (1577). The last great sailing ships, the *clippers* (1800's), had a similar arrangement, too. Clippers, such as the *Cutty Sark* (1868), were built with an emphasis on speed.

But by the mid-1800's, steam-engined ships burning wood and coal were rapidly replacing sailing vessels. They were first driven by paddle wheels at the sides, and then by propellers like modern ships. At the same time, iron was replacing wood as the main material for ship construction. The most spectacular iron ship built was I. K. Brunel's *Great Eastern*, 700 feet long with room for 4,000 passengers.

Above: The largest ships in the world are tankers, which may have a weight of over 250,000 tons.

Above right: A few rivers are large enough to have boats plying up and down, providing regular services. The *Delta Queen* carries passengers along the Mississippi River in the United States.

Right: Most ships end their days in the scrap yard and some on the sea-bed. A few great ships are preserved for posterity, such as Nelson's flagship *Victory*, which can be seen at Portsmouth, England.

By 1890, iron was itself being replaced by steel, the main material used today.

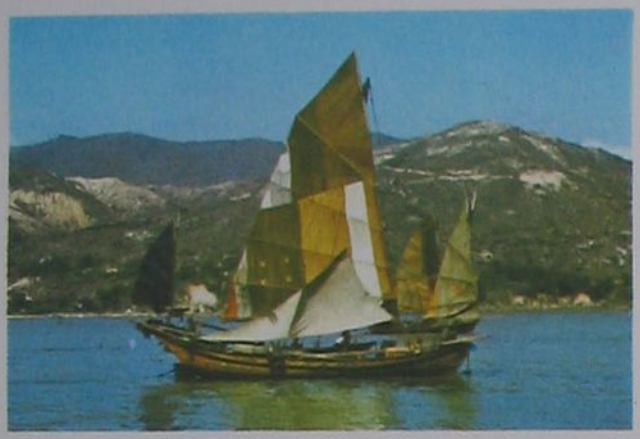
The great breakthrough in engine propulsion came in 1894, when Charles Parsons installed one of his steam turbines in a launch, *Turbinia*. Within a few years, every fast ship was built with efficient steam turbines, including the famous super liners *Mauretania* and *Lusitania* (1907).

Since the First World War (1914-18), oil has replaced coal as fuel for ships' furnaces. Some of the latest ships use nuclear fuel in a nuclear furnace, or *reactor*, to raise steam for the turbines. The United States submarine *Nautilus* (1954) was the first nuclear ship. The first nuclear surface ship was the Russian icebreaker *Lenin* (1958).

The latest ships are a triumph of modern engineering. They are scientifically designed for their particular purpose, be it carrying passengers on a luxury cruise or transporting crude oil to a refinery. They are equipped with the latest electronic devices for navigation to make crossing the seas easier and safer. They have radio, radar, depth-sounders and direction-finding equipment. Steering can be done automatically by the *automatic pilot*, which is linked to a gyrocompass.

The great passenger liners have powered stabilizing fins, which project into the water from the sides of the vessel.

The ships are safer now than they ever have been. Plastic has replaced wood for internal fittings, and everything is fireproofed. In some ships, heat-sensitive sensors pinpoint immediately any rise in temperature which may indicate a fire. The ship is divided into a series of watertight compartments, which can be sealed off in case the hull is punctured and so prevent general flooding.



Top: Ships are mainly used to carry cargo from port to port. The British vessel *Elmira Palm* carries logs to Tilbury Docks, London. Above: A junk at Macao on the southern coast of China. Below: The icebreaker *Biscoe* carves out a channel through pack ice.

Modern cargo vessels are highly specialized. *Tankers* carry not only oil but all kinds of other liquids as well, from orange juice to cleaning fluids. *Bulk carriers* carry dry cargoes of every kind in bulk, including coal, ore, sugar and grain. *Container ships* are increasing in importance. Goods are not loaded and unloaded separately but packed into standard-sized containers, which are much easier to handle.

Talking points

* Ships have been developing for thousands of years. Do you think that, with the nuclear-powered ship, they have reached the height of their development, or can you foresee any way in which they might be improved?
* Modern supertankers are over 250,000 tons in weight and can measure a quarter of a mile in length. Discuss the advantages and disadvantages of these giant vessels.
* The use of containers has made the transportation of goods by ship much more efficient. Discuss the ways in which it has done this.

Articles to read

Brunel; Compass; Navigation; Ports; Ship-building.

Shipbuilding Building a ship is very complicated and very expensive, but it need not take a long time. Using modern materials and the latest methods of construction, shipbuilders can complete a ship in a remarkably short time. Some shipyards, operating assembly-line methods of construction, can build an 800-foot tanker in under four months.

In the past, the *hull*, or body, of a ship was made by *riveting* hundreds of steel plates together one by one, and the plates had to overlap. Today, the plates are joined by *welding*, which needs no overlap, and a great deal of metal and weight are saved.

In addition, the hull is now constructed by *prefabrication*. Whole sections of it are welded together, under cover, in an assembly shop, and the hull is built up section by section instead of piece by piece.

However, there is a lot of work to be done before construction begins. To start with, a shipowner places an order with a shipyard for a vessel to meet certain requirements of cargo or passenger capacity, speed, and so on.

The *shipyard*, which is often in a river estuary, covers a large area. It has drawing offices, assembly and workshops, and sloping concrete ramps reaching down to the water's edge. These are the *building berths* where the ships are actually constructed.

In the drawing office, a marine architect works out a suitable design for the new ship and prepares detailed drawings.

The prepared drawings go to the *mould loft*, where skilled men prepare patterns for the steel plates which make up the ship. In the *plate shop*, powerful gas cutting torches follow the line of the patterns and cut the steel to shape.

Plates for the curved parts of the ship's hull, especially the bow (front) and the stern (back), have to be bent. This operation is carried out by massive hydraulic presses which bend the thick steel plates easily. The properly shaped and curved plates are then welded into sections in the *assembly shop*.

During construction, the ship is supported by heavy wooden blocks under the keel. Travelling cranes along each side of the berth swing sections into position. An army of goggled welders join the sections together. Gradually the ship takes shape. The keel, the sides, the side-to-side bulkheads, and the deck plates are put together. The ship is enveloped in a network of scaffolding from which welders and painters work.

When the basic construction is finished and the hull painted, the ship is ready for launching. A wooden greased *slipway* is built beneath to guide it into the water. It is usually launched stern first, and sometimes sideways.

After launching, the ship goes to the fitting-out yard to be finished. There, the engines, boilers, and all the other machinery are installed, the superstructure (upper part) of the vessel completed, and the cabins decorated and furnished.

Shops are permanent places, such as rooms or buildings, where goods are sold to the public. A shopkeeper or owner is a *retailer*. He often gets his goods from a *wholesaler*, a trader who sells in quantity to other businesses, but not to the public.

In most countries today, shops are the commonest kind of retail business. But there are other kinds of retail selling as well. Some retailers sell their goods in a market or bazaar or from an open stall.

People have been buying and selling goods since long before recorded history. Permanent shops are known to have existed 5,000 years ago. The Greeks and Romans had well established shops, including those that specialized in certain items. After Rome fell, that kind of retailing declined in favour of market trading. Shops re-appeared in the 14th century. By the 18th century, small speciality shops of all kinds were doing a brisk trade in the cities of Europe. In the rural areas, travelling merchants were common, as were general stores which provided necessary food, clothing, and household items within a limited range of choice.

STAGES IN SHIPBUILDING

1. The first stage with plating completed.

2. The main watertight bulkheads erected.

3. Progress on sides and propeller shaft tunnel.

4. Completing plating and bulkheads for F deck.

5. Deckhouse bulkheads in position on E deck.

6. B and C decks and stern take shape.

Above: The staff pose in front of a fine display of Christmas poultry in 1919. The public then expected personal attention. Right: A modern supermarket. Customers help themselves and pay at the cash desk. Supermarkets sell a wide variety of goods. This way of shopping is more convenient, but many find it less friendly.

In the 1860's a Parisian draper's shop turned itself into the first *department store* and similar stores soon opened in other places. A department store sells a wide variety of goods—clothing, appliances, furniture and foods, for example—in separate departments, but all under the one roof. Because of its size, a department store can offer its customers special services such as delivery and *credit* (an extended time in which to pay the bill).

In the mid-1800's, the first *chainstores* came into existence. These are shops with a number of branches in different places, all under one ownership. The first of these were grocers and chemists, but chains of butchers, dry cleaners and bakers followed.

Supermarkets—that is, large, self-service local food shops—first opened in the 1930's in the United States. The best-known of these operate as large chain-stores. Small shopkeepers sometimes find that they cannot compete with the cut prices offered by the big supermarkets and they have to close down. Many people still prefer the friendly corner shop to the sleek new supermarkets.

Suburban *shopping centres* are one of the newest developments in retail business. A typical one has a wide range of shops located in one area. There are ample parking facilities for customers. Some centres have shops on several levels, with a protecting roof overhead. Traffic is barred from the streets, so that shoppers can stroll in comfort from one shop to another. There are usually cafés and restaurants provided, and places to sit and rest.

2
3
Next Customer
POTATO CRISPS

Shorthand is a way of writing rapidly by using simple symbols to represent sounds instead of combinations of letters. The symbols are designed so that they can be written fast enough to write down what a person is saying as he says it. Shorthand is used by secretaries to take letters and by reporters in interviews. But it is being replaced by the use of tape recorders.

Shorthand was used by the Ancient Romans. The earliest English shorthand dates from 1588, and there have been hundreds more systems since. There are now three main systems in use: *Pitman* (dating from 1837), *Gregg* (1888), and the *Thomas Natural* system (1935). All these systems use symbols. A fourth system, called *Speedwriting*, uses ordinary letters to form abbreviations of words. It was invented in 1923. Speedwriting may be learnt more quickly than symbol shorthand.

Shropshire (area 1,346 square miles), also called *Salop*, is an English county on the Welsh border. Its county town is Shrewsbury, and its population is 337,000.

The River Severn flows across the county from north-west to south-east. To the north of the river the land is generally flat and level. The land south of the Severn is hilly, rising to nearly 1,800 feet in the Clee Hills. There are several lakes in the north-west.

Shropshire is largely an agricultural county. Cattle and sheep are reared in the south, and there are many dairy farms in the north. Coal and iron were important in the past, but most of the mines are now worked out. The main towns, apart from Shrewsbury, are Wenlock, Wellington and Oswestry. The remains of castles close to the Welsh border are tourist attractions.

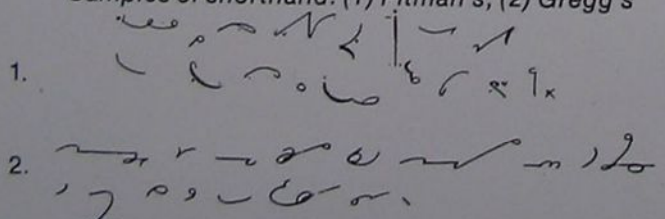
Siberia covers most of Russian Asia, east of the Ural Mountains. Siberia is a very cold but dry land with a long Arctic coastline. Its western plains slope upwards to the Altai and Sayan mountains, near Mongolia, and to other ranges in the east. Lake Baikal, which is larger than Belgium, lies near Mongolia. Forests cover about a third of Siberia's 5,850,000 square miles. Siberia is rich in minerals, including coal, oil and natural gas. Farming is important in the south-west.

In 1581, Yermak, a Cossack pirate, chased the Mongol Tartars eastwards. During the next hundred years, Russian hunters and trappers, and private expeditions, advanced 4,000 miles across the almost empty land until they reached the Pacific coast. From 1710 to the 1950's political and other prisoners were sent there.

In 1922, the communist government incorporated Siberia into Russian Soviet Federal Socialist Republic. In the 1960's, the government encouraged young Russians to settle there to develop Siberia's economy as fast as possible.

Sicily is a large, triangular Mediterranean island, lying just off the southern tip of Italy. It makes up a mainly self-governing region of Italy. Palermo is the capital. Most of Sicily's area of 9,926 square miles is mountainous. Earthquakes and volcanic

Samples of shorthand: (1) Pitman's; (2) Gregg's



Common sense is the most widely shared commodity in the world, for every man is convinced that he is well supplied with it. René Descartes (1596-1650)

Isaac Pitman classified the sounds of English scientifically. His system shows consonants by thick or thin straight lines and shallow curves. Vowels can be shown by light and heavy dots and dashes, but these are often left out. The position of a consonant in relation to the line can also indicate the vowel. John Robert Gregg based his shorthand on a scientific study of handwriting; the characters are based on ordinary longhand and the vowels inserted without lifting the pen. There is no variation of the position of words in relation to the line, or thickening of the strokes. Pitman's shorthand is more common in Britain, and Gregg's in the United States.

The elaborately painted and finely carved cart is an example of traditional Sicilian craftsmanship.

eruptions occur from time to time. Mount Etna, Europe's highest active volcano lies in the east of the island. The land, though fertile, is too dry for farming without extensive irrigation. The region is poor and backward and its development has also been hindered by a secret criminal society called the *Mafia,* which has a great hold on the island. Unemployment is high and many Sicilians have emigrated to the mainland of Italy and foreign countries.

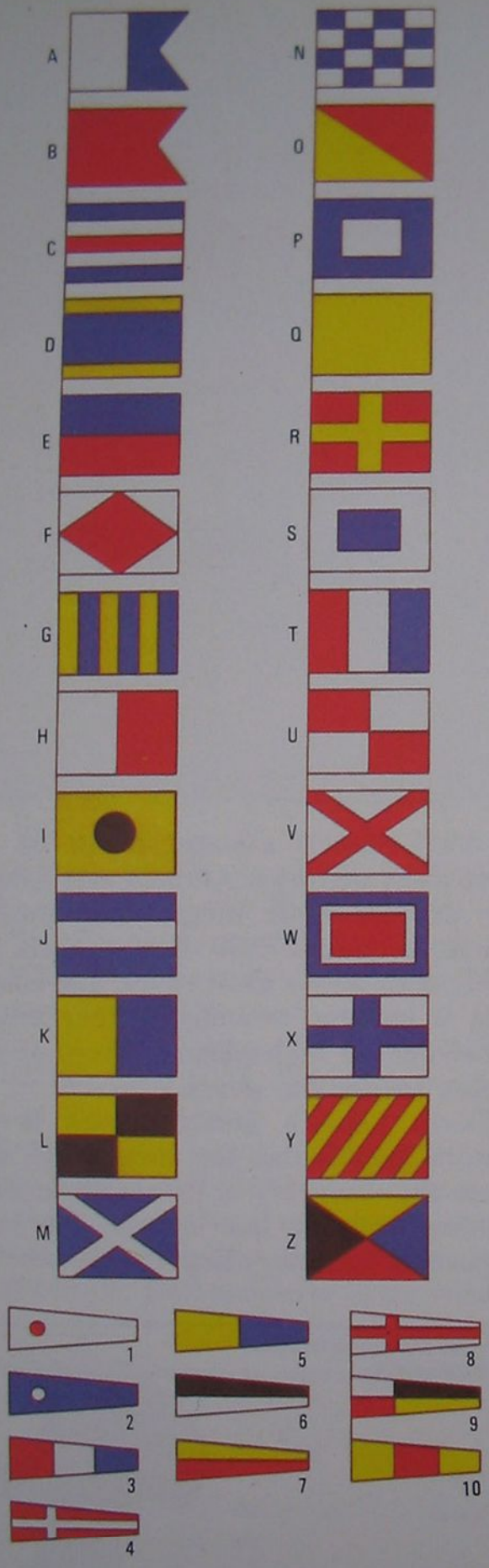
Most of Sicily's 4,809,000 inhabitants work on farms that produce wheat, citrus fruits, wine grapes, olives and tomatoes. Others fish for tunny and sardines. Oil, chemicals, salt and sulphur are valuable exports.

Once a colony of Greece, and later part of the Roman and Byzantine Empires, Sicily has been invaded by many different groups in its history. The Spaniards ruled from the 1400's until 1860, when Giuseppe Garibaldi freed Sicily and made it part of a united Italy.

Sierra Leone is a young nation on the west coast of Africa. Guinea and Liberia are its immediate neighbours. Most of Sierra Leone's 27,699 square miles are sandy with only a grass cover. The coastal area is low and swampy; farther inland, it becomes a high plateau. Tropical rain forests border the rivers.

Sierra Leone's greatest asset is the mineral wealth that lies beneath its soil. Since the discovery of diamonds in 1930, diamond mining has become the most important industry. Exports of iron ore

The map shows the location of Sierra Leone.



THE INTERNATIONAL CODE OF FLAG SIGNALS

and bauxite bring in additional money. Many people in Sierra Leone work on the land. They grow rice to eat, and palm kernels, cacao beans and coffee for export. Most of the country's 2,500,000 people are black Africans, mostly of the Mende and Temne groups. Most of them live in villages. Apart from Freetown, the capital and main port, there are no towns of any importance.

After the Portuguese first came to Sierra Leone in 1460, the region was used as a source of slave labour, especially for America. In 1787, Freetown was founded as a home for freed slaves. Britain made Freetown a colony in 1807, and in 1896 established a protectorate over the rest of Sierra Leone. The country became an independent nation within the Commonwealth of Nations in 1961, and a republic in 1971.

Signalling is a method of sending information from place to place or of giving information. All signals are received either by the eye or by the ear.

Semaphore is a way of passing messages by visual signals. The sender holds a flag in each hand, and moves his arms into various positions to spell out letters of the alphabet. Railway signals tell a train driver to stop or go in much the same way. Both these ways of visual signalling are not used very much nowadays. But we are given a similar visual signal every time we look at a clock or watch, or are directed in traffic by a policeman. Navies signal messages visually by hoisting flags. The flags stand for letters as well as for advice. Thus the flag for P can also mean that a ship is about to leave port.

Many years ago, piles of wood were kept ready on hill tops in times of danger. They would be lit to signal an invasion of a country. American Indians signalled messages by waving a blanket over a fire to produce puffs of smoke in the sky. These smoke signals would spell out a message.

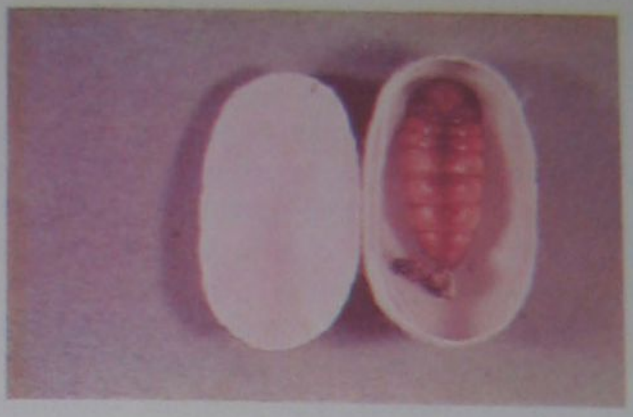
Modern visual signals take the form of lights. Traffic lights and illuminated railway signals give information about whether it is safe to proceed. At airports, huge beacons of flashing green tubes spell out an identification signal that can be seen by aircraft for miles around. Rows of coloured lights indicate the runways at night, just as a lighthouse or lightship warns shipping of dangers.

Before the invention of radio, messages were sent over long distances by *heliographs*, lights that flashed in Morse code by reflecting the sun's rays (see Morse code). But with radio, communication could be made by voice. Voice communication by radio or telephone is vital to our lives today.

Signals can be made by sound without the aid of radio, if they do not need to travel far. In fog, a lighthouse warns shipping away by sounding a loud foghorn in regular blasts. The drum signals of African tribes are famous. The approach of an enemy could be signalled to all tribesmen within miles by playing the drums in a certain rhythm.

Silica (SiO_2), a solid *compound* (a material made up of two or more substances) of silicon and oxygen, is the most abundant material in the Earth's crust. It comprises almost every kind of rock and sand. *Quartz*, one of its crystalline forms, is used in radio equipment, and is melted to make glass. Silica is found in the skeletons of microscopic animals called *diatoms*. Some plant stems also contain the compound. Silica and *silicates* (related compounds) are useful materials because they are hard, difficult to dissolve, and they melt only at a very high temperature.

Silk is a thread obtained from the cocoon of the silkworm moth. Cloth made of silk is valued highly for its beautiful lustre and 'silky' texture. Silk fibres are strong, elastic, and so smooth that dirt does not cling to them. The world's leading silk-producing countries are Japan and China.



Above: The cocoon of a silkworm moth, cut in two to show the pupa of the moth inside.

Right: A Japanese Oak Silk Worm

Below: Italian workers sort through a load of silk cocoons, rejecting any that are unsuitable for making thread.

Silk is made by rearing silkworm moths in controlled conditions. The eggs they lay are placed in incubators, and hatch out into tiny black silkworms, the caterpillars of the moths.

The silkworms are fed on mulberry leaves, the only food they will eat. They grow quickly, shedding their skins four times, until they are ready to *pupate*. At this point, the farmer places the silkworm in a special container and it spins a cocoon of silk around itself. If

the cocoon is left, an adult silkworm emerges later. The farmer leaves a few to obtain moths to lay more eggs. But he kills most of the pupae inside the cocoons by heating them in an oven.

The silk fibres must now be unwound from the cocoons, a job called *reeling*. The cocoons are soaked in warm water, and then the ends of about six threads are taken and carefully wound together on a reel into a thread. The thread obtained may be nearly a mile long, and is called *raw silk*. The raw silk is next washed and dried, and then twisted into thicker yarns by a process called *throwing*. It is then boiled in soap to remove its natural gum. It can then be dyed and woven into cloth.

Silk is believed to have been discovered more than 4,000 years ago in China. A legend goes that a young empress watched a silkworm weaving its cocoon in a mulberry tree. She placed the cocoon in a cup of tea she was drinking to soften it and pulled out a beautiful thread. She then cultivated enough silkworms to make cloth. Whether this story is true or not, until A.D. 550 only the Chinese knew how to make silk and they guarded their secret jealously. Then the Roman Emperor Justinian discovered the secret from two monks sent to China to bring back some eggs.

There are several varieties of silkmoths. Some produce white silk and some yellow silk. Most of them pass through several generations each year. Eggs laid in autumn are kept in cold storage until the mulberry leaves open in spring.

Silver has been used for hundreds of years to make beautiful tableware and jewellery. Like gold, silver can be shaped easily and resists corrosion well. But it tarnishes in towns because sulphur in the atmosphere attacks it to form a black layer of sulphide. Silver conducts heat and electricity extremely well, but it is too expensive to use on a large scale.

Articles of Silverware

Silver is harder than gold but is too soft for constant wear. Mixed with a little copper to form sterling silver, it is suitable for jewellery and tableware. Silver is often plated on other metals or alloys to give relatively inexpensive silver plate. It is deposited on glass to make mirrors.

By far the biggest use of silver today is in the form of chemical compounds. Silver iodide and bromide are sensitive to light and are used to make films.

Silver is often found in the pure state in the ground, but much silver comes from the sulphide ore argentite.

Silver plated cutlery is often stamped E.P.N.S. which stands for electroplated nickel-silver (nickel silver is an alloy of copper, nickel, and zinc).

Singapore is the capital of the Republic of Singapore. It occupies about 30 square miles of the island of Singapore, opposite the southern tip of the Malay Peninsula. A causeway carrying rail and road, three-quarters of a mile long, connects the city with the mainland.

The city owes its prosperity to its position on the main world sea and air routes and as a connecting link between India and the Far East. Its port, with deep water wharves and ship-repairing facilities, is one of the largest seaports in the world. It is also the principal port for the Malay Peninsula.

Tiger Balm Gardens, Singapore, were built by the manufacturer of an ointment called Tiger Balm.

The population of Singapore numbers over two million, mainly Chinese, and almost half live within the city proper. Rapid growth has necessitated the building of housing and industrial estates to form satellite towns.

Sitting Bull (1834?-1890) was a famous Indian leader in the United States. He belonged to the Sioux nation. Some people believe that he led the Sioux in the Battle of Little Bighorn. This battle took place in 1876. It resulted in the massacre of General George Custer and his force of 200 men. Sitting Bull certainly helped his people to prepare for the battle. But there is no proof that he took part in the fighting.

Sitting Bull was born in what is now South Dakota. He became a medicine man. He taught the Sioux that they must fight and kill their enemies, the white settlers, if they wished to stay free and keep their lands.

After the Battle of Little Bighorn, the Sioux were driven into Canada. They returned to the United States in 1881. Sitting Bull submitted to living on a reservation. In 1890 he began to rouse the Indians again. The U.S. government feared he would start an uprising. They sent policemen to arrest him. In the resulting confrontation Sitting Bull and his son were killed.

Skating is the art of moving on ice, or on a level floor, by means of a pair of ice-skates or roller-skates attached to the boots. Ice-skates have a steel blade; roller-skates have a set of four wheels.

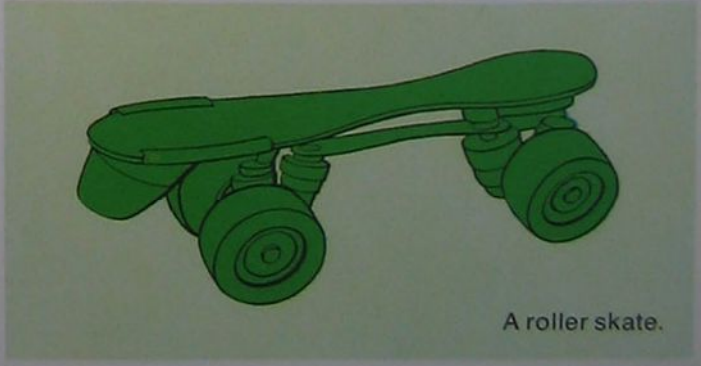
Skating probably originated in Scandinavia on bone 'runners' more than 2,000 years ago. Today, competitive skating has many different forms, including figure, dance, and speed skating, and ice hockey, each of which is popular on a world-wide scale on either ice-skates or roller-skates.

Speed-skating is the oldest branch and today International Championships are decided over 500, 1,500, 5,000 and 10,000 metres.

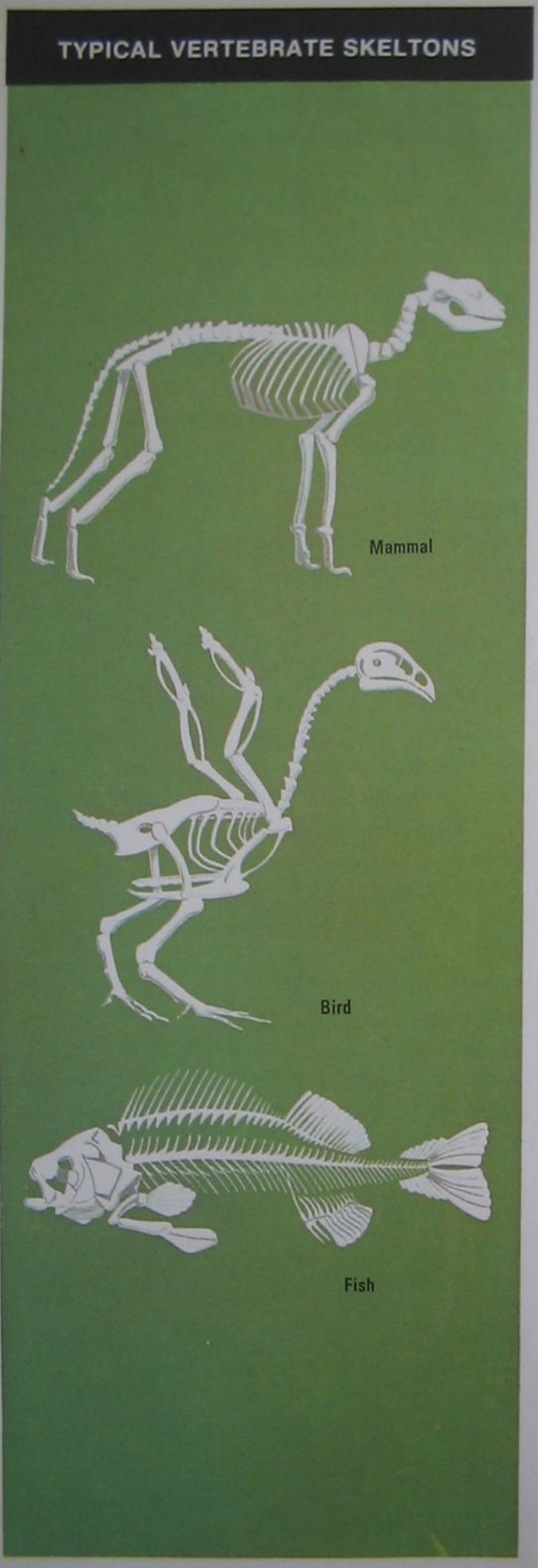
The first known roller-skate was devised by the Belgian J. Merlin, in 1760, although this was unsuccessful. The first successful four-wheeled roller-skate with a movable platform was patented in 1863 by an American, James Plimpton.

Individual skating is divided into 'compulsory figures', i.e. the skating of exact movements according to a special schedule, and 'free skating', being the skating of unprescribed movements, to music. Ulrich Salchow (Sweden) won ten world titles for men's figure skating (1901-1911). Sonja Henie (Norway) won the same number for women's figure skating (1927-36).

Ice hockey originated in Canada in 1860, and has been played professionally in North America since 1893. Teams are six-a-side, with substitutes permitted. A rubber disc, called a *puck*, is used instead of a ball. (See Ice Hockey.)

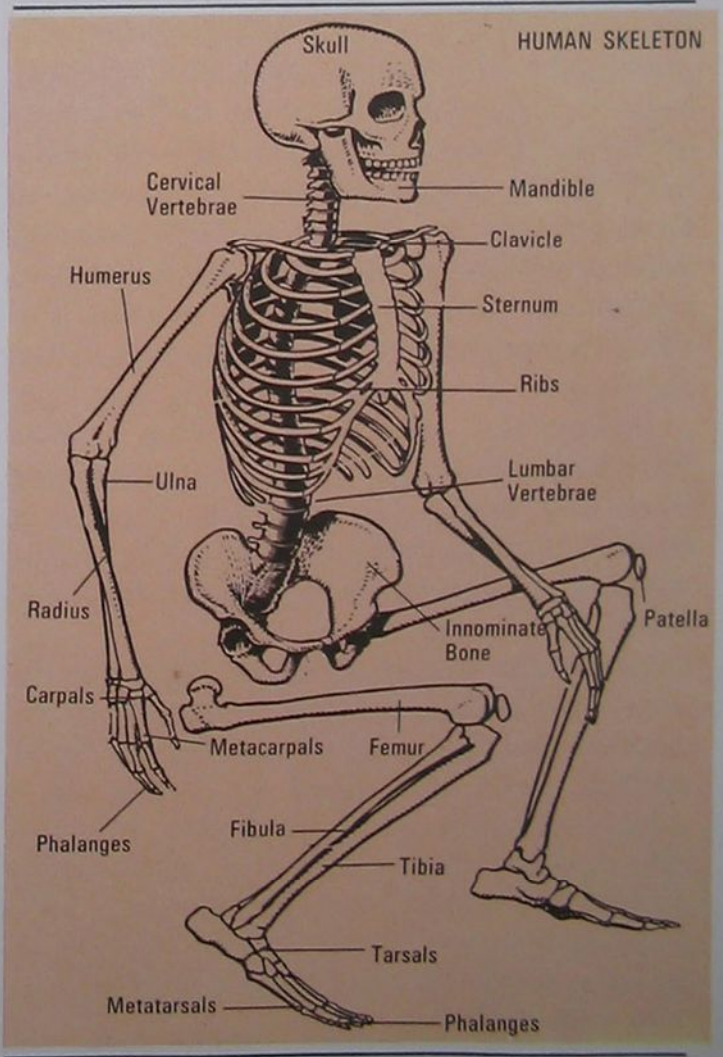


A roller skate.



Skeleton This is the hard framework of an animal's body. In *vertebrates* (animals with backbones) such as fishes, reptiles and mammals, the skeleton is enclosed in the body. This is called an *endoskeleton.* But many *invertebrates* (animals without backbones) also have skeletons. Theirs is a shell-like *exoskeleton* (external skeleton) that covers the body. The skeletons of vertebrates are made up of individual bones (see Bone). In some creatures, the skeleton may be made of *cartilage* (gristle).

The main jobs of the skeleton are to support the animal's body and to aid movement. It also protects the body's vital organs and gives the body shape. It acts like a system of rigid girders. The soft parts of the body hang from it, and the whole mass does not collapse in a heap. Land animals need a much stronger skeleton than animals that live in water, because water supports a large part of a creature's weight.



A skier descending the edge of a large snowdrift at Banff, Alberta, in Canada.

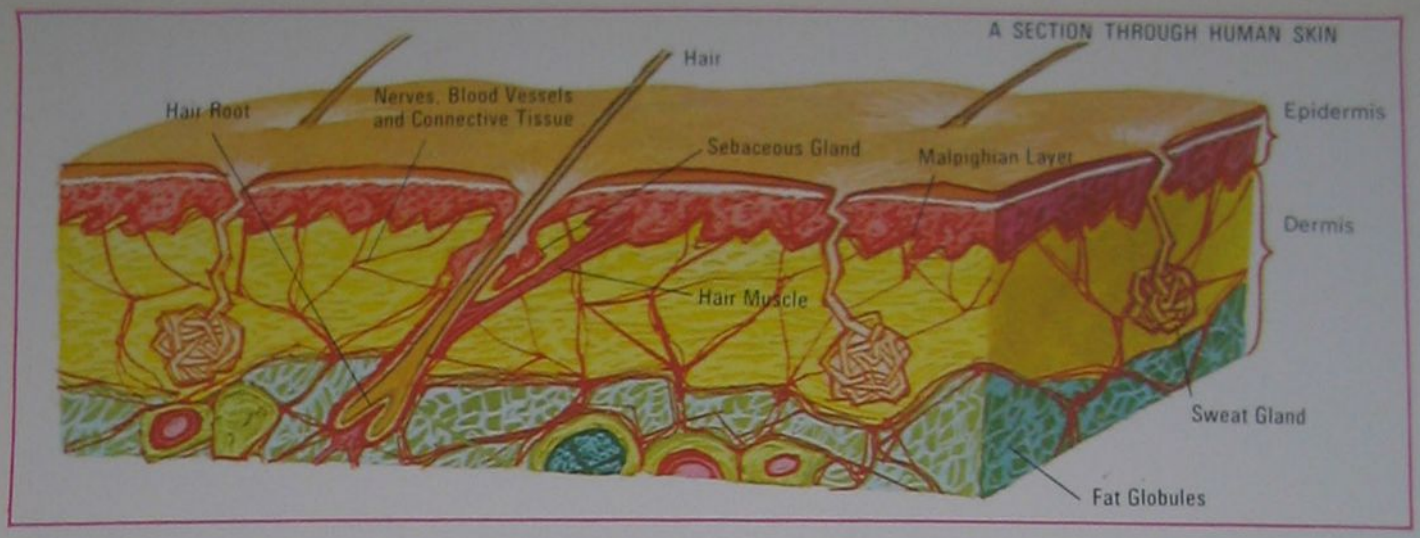
In all but the simplest animals, movement is carried out by muscles that shorten or lengthen. For this system to work, the muscles must be firmly attached to some support. The skeleton provides this support. The various bones hinge on each other at the joints, and by pulling on a pair of bones either side of a joint, a muscle can cause movement.

When the bones move in this way they act as levers. The joint is the *fulcrum* (pivot); the muscle provides the *force* that produces movement; and the *load* is the weight of the part of the body moved and anything it is carrying.

Bones hinge on each other in various ways. A person's knee and finger joints are examples of *hinge* joints. The bones can move only in one direction, like a hinge. The joint at the hip is a *ball-and-socket* joint. The rounded end of the thigh bone fits into a socket (hollow) in the pelvis (hip-bone). This means that the joint can move in all directions, not just backwards and forwards. Some other joints allow virtually no movement at all—those between the various bones of the skull, for instance. These bones are held tightly together.

Skiing As long as 4,000 years ago the people of Scandinavia discovered that they could move more easily over the snow by means of skis. These were strips of wood about 9 feet long and 4 inches wide fixed on to each foot with the points of the skis pointed and curved upwards at the front to ride over the snow. Today, most skis are made of metal or plastic and are shorter but still in principle the same.

Over the centuries Norwegians, Swedes and Finns used skis for hunting, for warfare and competition. Then, in the early part of this century, the people of the Alps also took up skiing for competitive purposes and started downhill racing. Down-



hill racing has since developed into three main types: the downhill, in which the skier has considerable freedom to choose his own line; the giant slalom, an event in which gates are placed at intervals across the mountain to test control and make the best use of the mountain; and the slalom in which gates are placed very close together to test technique and agility.

In 1924 skiing events were introduced into the Olympic Games but at that time only consisted of Nordic, cross-country and jumping events. Alpine events, i.e. downhill and slalom, were first introduced into the Olympic Games in 1936. Christel Cranz, a German girl, holds a record of 12 World Titles plus the gold medal for the Olympic combined event in 1936.

The greatest Nordic race is the 'Vasa Lopp' which commemorates an 85-kilometre ski journey made by Gustav Vasa, later King Gustavus Eriksson, in 1521, from Mora to Salen, Sweden. This journey is now re-enacted in the reverse direction as an annual event and attracts around 8,000 competitors, all of whom start off together.

For ski-jumping events, competitors descend a slope to gather momentum before leaping from a high platform to land on another slope below. The longest ski-jump recorded is 154 metres (505·2 feet) by R. Bachler of Austria on Vikersund Hill, Drammen, Norway in 1967.

Skin is more than just the covering of the body; it is an essential organ. It helps to protect the body from injury and acts as a barrier against germs and harmful chemicals. But, just as important, it helps the body to keep a steady temperature and to get rid of waste.

The skin is made up of two distinct layers: the inner *dermis* and the outer *epidermis*. The inner part of the epidermis, the *Malpighian layer*, consists of live cells. It contains the pigment that gives the skin its colour. As new cells form, they push the older ones outwards, so the outer part of the epidermis consists of dead cells. These gradually wear or flake away, but may form hard, horny layers in some places, such as corns on the toes.

The dermis, unlike the epidermis, contains nerves and blood vessels. Hairs grow out of this layer (see Hair). The upper surface of the dermis is uneven, and this unevenness is followed exactly by the epidermis. This shows up in finger-prints, which never change because the underlying dermis never changes. The dermis also contains sweat glands, which open onto the surface and release water and waste materials.

Sweating also helps to cool the body. The water evaporates from the skin and cools it. When the body temperature rises, the blood vessels in the skin also widen, and carry more blood to the surface. There the air cools it. When the body tempera-

ture falls, the blood vessels contract, allowing less blood to reach the surface and lose its heat. 'Goosepimples' may also appear and the hairs may stand on end. This traps a thicker layer of air round the body which helps to keep it warm, though it is not a very efficient mechanism in man because of his lack of hair.

Skin diving is diving and swimming freely under the surface of the water. Some skin divers use no equipment at all. Other skin divers wear a few simple pieces of equipment. *Swim fins* or *flippers*, worn on the feet, give the diver greater push in the water. A *face mask*, worn over his eyes and nose, helps him see better. And a short breathing tube, called a *snorkel*, enables him to remain at a shallow depth for a long time.

Some divers, called *scuba divers*, carry cylinders of compressed air on their backs. This allows them to stay underwater for a long time. The word *scuba* comes from the first letters of the words *self-contained underwater breathing apparatus*. Scuba divers often wear protective rubber outfits, called *wet suits*.

Many people skin dive as a sport or recreation. They enjoy studying the life of fish and other living things in the sea.

Other people skin dive for a living. These include spear fishermen and people who dive for pearl oysters or sponges.

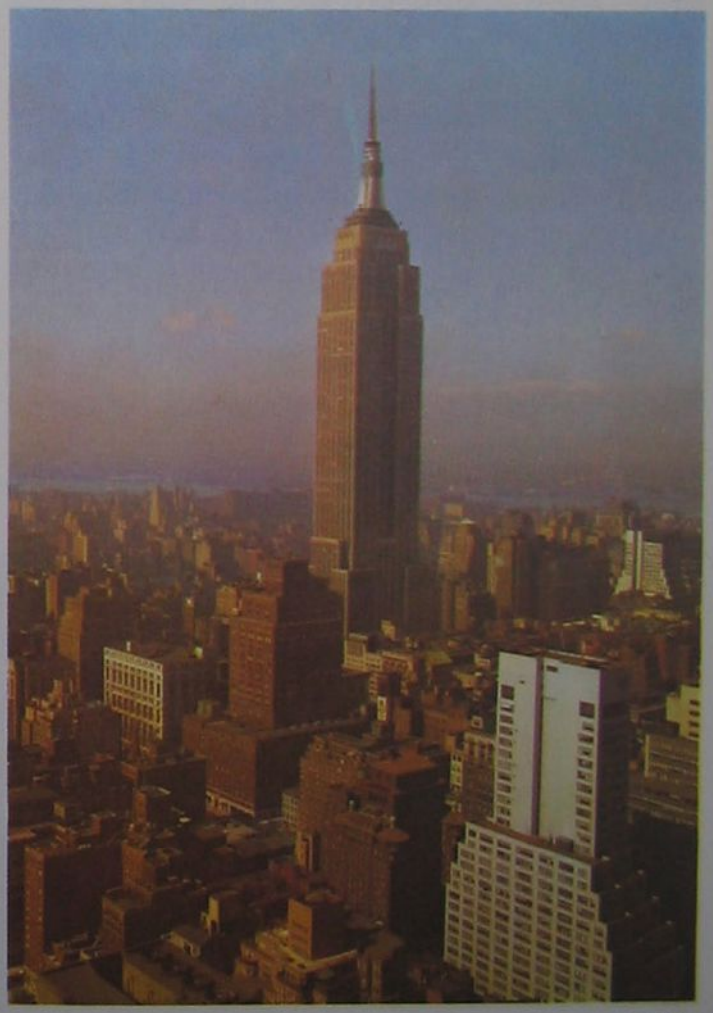
Skunk The skunk is a mammal about the size of a large cat, best known for the strong, nasty smell it produces when attacked. This smell comes from a fluid produced by glands near the base of the skunk's tail When scared, the skunk turns round and squirts a fine spray of the fluid at its enemy.

Skunks are related to weasels, badgers and otters. They have long hair and bushy tails. The commonest kind has broad black and white stripes along its back. Another kind is spotted. Skunks live in open country and woodland in North and South America. They eat small animals, insects, grubs, eggs and plant food.

A Hooded Skunk

Skyscraper is the popular name given to very high buildings. The first skyscrapers were built in Chicago and on Manhattan Island in New York City. The World Trade Centre in New York, was the world's tallest skyscraper at the beginning of 1973. It stands 1,353 feet high and has 110 storeys.

The Empire State Building in New York City.



Such high buildings can be built in Manhattan because solid rock just beneath the surface provides firm foundations for them. In soft ground, skyscrapers can still be built, but concrete piles must be sunk down to firm soil.

Some skyscrapers are so high that their designers must strengthen the structure to allow for the effects of the wind.

The use of steel and concrete construction made the development of skyscrapers possible. So did the invention of a safe lift, or elevator. All lifts have safety devices to prevent them falling if their supporting ropes break. A lift in the Empire State Building (1,250 feet) falling freely would hit the ground at a speed of about 180 miles an hour!

Slavery A slave is a human being who belongs to another human being, like an animal. A slave is a piece of property and can be treated badly or well, as his owner likes. In primitive societies when men were captured in war they were either killed or made slaves. In ancient societies slaves made many of the things people used. Slavery is an insult to human dignity and naturally there were slave revolts. One of the greatest was led by Spartacus, whose army of runaway slaves defeated the Romans for two years (73-71B.C.).

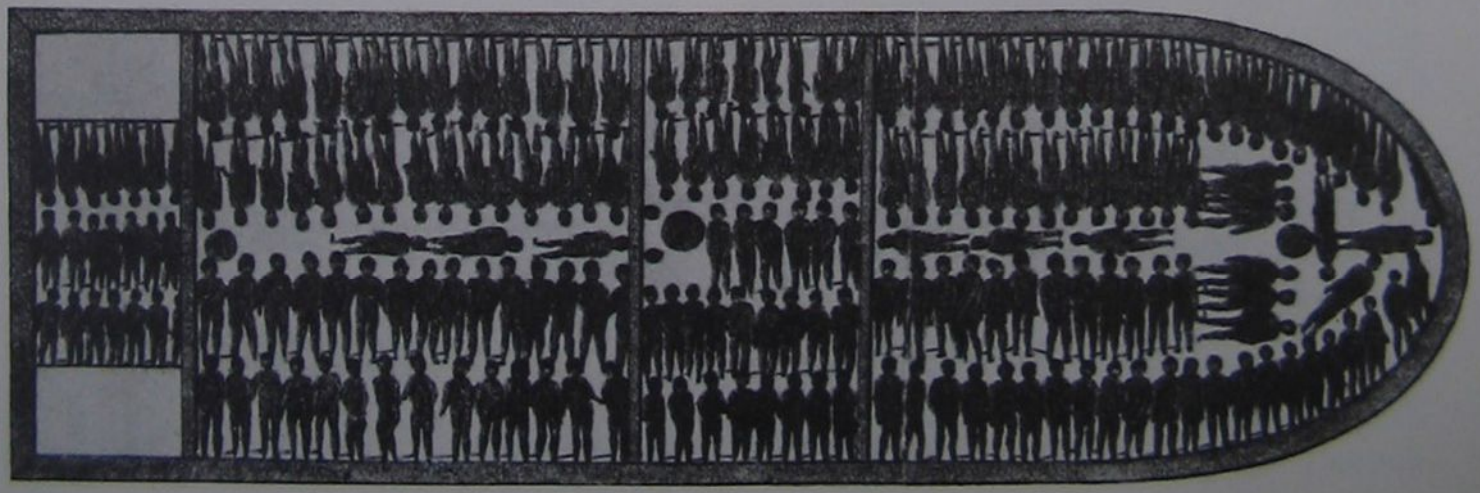
The Christian Church had support from slaves. It did not oppose slavery outright but encouraged Christians to free their slaves. Slavery began to disappear when it was found that free peasants produced more goods than slaves. In 1772 Lord Mansfield, the Lord Chief Justice, ruled that a slave landing in England automatically became free.

Slavery began to grow again when it was found that African Negroes worked better than the native Indians on the sugar, tobacco and cotton plantations of the West Indies and North America. British merchants made huge fortunes out of capturing African Negroes and selling them as slaves in the New World. Conditions on board the slave ships were terrible, and many died. Missionaries began to protest, and public opinion in Britain became hostile. The slave trade was made illegal in 1807. In 1834 all slaves in the British Empire were freed.

Other countries followed the British example. The biggest problem was in the U.S.A. The northern states had no need of slaves and opposed slavery; the southern states depended on slavery for their prosperity. Only a war (see Civil War, American) ended slavery in the U.S.A. Slavery still exists in a few countries even today.

Sleep and dreams Sleep is a period of rest and recovery for the body. Human

A diagrammatic print showing slaves packed on a slaver. Thousands died on the long journey across the Atlantic as a result of appalling overcrowding and atrocious conditions.



beings and many animals need periods of sleep or they will die.

When a person sleeps, his eyes close and his muscles relax. He loses consciousness of time and of most events around him. But he is not completely cut off from the world. A loud sound, such as the ringing of an alarm clock, will usually wake him. And even a slight sound can alert him if the circumstances are right. A mother, for example, often wakes at the first sign of her baby stirring.

People's sleep habits vary greatly. Most people sleep at night, when it is dark. But night workers have to sleep during the day. Seven or eight hours of sleep a night is normal for many adults. Some adults require much less and others require more. Infants and young children spend a much greater part of their time asleep than adults do.

People also vary in how much they move in their sleep. Some toss and turn. Others move only a few times in the night. Some people walk in their sleep. A sleepwalker's mind is completely asleep, and in the morning he may have no recollection of his nocturnal wanderings.

Sleep is not an even process. During the night depth of sleep varies in fairly regular cycles. Deep sleep alternates with lighter sleep.

Dreaming is a period of mental activity during sleep. During a dream, a person's mind creates pictorial images. Usually, these images make up a story of some kind. Some people dream in colour, others only in black-and-white. Dreams differ from ordinary waking thoughts. They are generally less connected and coherent and are much more fanciful. In dreams, people allow themselves to have thoughts they would not normally think. For this reason psychologists believe dreams indicate our deepest and most secret wishes and fears. The psychologist Sigmund Freud believed that dreams have a meaning which is expressed in symbolic language.

In the past, many people thought that dreams could foretell the future. In the Bible, for example, the Pharaoh tells Joseph a disturbing dream in which he saw seven lean cows eating seven fat ones. Joseph explained that the dream meant seven years of good harvests would be followed by seven years of famine.

Sleep is essential for the normal functioning of the bodily processes. People who are deprived of sleep become short-tempered and unable to concentrate for long periods of time. If deprived of sleep for more than a few days, a person starts to suffer from hallucinations, and begins to distrust the people around him.

Researchers have discovered many interesting facts about dreaming. For example, they have shown that everyone dreams every night—usually three or four times. A typical dream lasts 15 to 20 minutes. The dreamer may or may not remember having dreamt. But anybody looking at him can tell when he is dreaming by observing his eyes. During dreaming a person's eyes make many small, quick movements, called REMs (rapid-eye-movements).

Scientists have also proved that dreaming is essential to our emotional well-being. In experiments, people who are allowed sufficient sleep but are prevented from dreaming (by waking them when they show REMs) become extremely tense and disorganized. People who are wakened the same number of times when they are not dreaming do not show these effects.

Sloth The sloth is a slow-moving, long-haired mammal of South America. Sloths live in trees and seldom come down to the

A three-toed sloth. Sloths use their hook-like claws to walk upside down along branches. They move about very slowly. People who are slow and lazy are sometimes called 'slothful'.

ground. Their feet have large, hook-shaped claws, with which they cling to branches. They generally move about upside down, hanging beneath the branches. They even go to sleep in this position.

There are two main kinds of sloths. The two-toed sloth has two toes on each front foot and three on each hind foot. It feeds on the leaves, shoots and fruit of various trees. The three-toed sloth has three toes on each foot. It eats only the leaves of the cecropia tree.

Slow worm This animal is not a worm, nor a snake, but a legless lizard. It differs from a snake in having movable eyelids and a notched tongue. Its tail may break off if it is handled roughly.

Slow worms live in most countries in Europe, parts of northern Africa, and as far east as south-east Asia. Most slow worms are grey-brown in colour, often with a copper sheen. Slow worms feed on slugs, worms and insects. The female has a litter of 6 to 12 live young, sometimes as many as 20, and the animals grow to a length of about one foot. Slow worms have lived for up to 54 years in captivity.

Smuggling is the illegal taking of goods into or out of an area. People generally smuggle to avoid customs duties. Customs officers try to prevent smuggling. They examine the luggage of travellers entering a country at border posts, seaports and airports. They search ships for *contraband* (smuggled goods), sometimes boarding them at sea. Anyone who brings into a country articles on which duty is payable, such as cameras, without *declaring* them is smuggling. Every state prohibits smuggling, and imposes penalties ranging from fines to imprisonment.

In Britain the 'golden age' of smuggling was between the time of Elizabeth I, when large customs duties were imposed, and the 1840's, when the government adopted a free trade policy. Tea and spirits were among the main targets.

Cornwall used to be famous for its smugglers. The little bays and coves were ideal for bringing in contraband from the French coast. Some Cornishmen were *wreckers*. They lured ships onto the rocks at night by signalling to them with lanterns.

Nowadays smugglers often use aircraft and carry easily transportable goods. International gangs smuggle gold and diamonds worth vast sums. Diamond smugglers cost the diamond fields in South Africa more than £10 million each year. A new form of smuggling is the carrying of illegal immigrants into countries such as Britain and Hong Kong.

But perhaps the most profitable form of smuggling is of narcotic drugs such as cocaine and heroin. Smugglers carry millions of dollars worth of these drugs into the United States. A government

Smugglers breaking down the door of the King's Custom House at Poole, Dorset, in 1747. During the 1700's, many gangs of smugglers sprang up in Britain. They were often brutal in their methods

On beaching, a smuggler's lugger would be met by a party of some 30 men. Some were 'porters' who carried the roped tubs and packing cases on their shoulders; others, known as 'swinglers', men armed with threshers or long cudgels, would fan out on either side of the porters to ward off attacks from preventive patrols.

agency tries to combat this terrible menace, but it is powerless to prevent the smuggling completely. So long as they can make high profits, smugglers will take advantage of people's weaknesses.

Smuts, Jan Christiaan (1870-1950), a celebrated South African statesman and soldier, played a leading part in world affairs, and in forming his country's union. He helped to establish the League of Nations in 1920 and the United Nations Organization in 1945.

Born in Cape Colony to a family of Dutch descent, Smuts studied at Cambridge University, where he obtained a law degree. He returned to South Africa in 1895 and settled in the Transvaal. When the Boer War broke out in 1899, he commanded the Boer armies in Cape Colony and organized a number of daring guerrilla raids against the British. After the Boers had been defeated, he did everything he could to reconcile the two sides.

Smuts drafted the constitution of the Union of South Africa, which was adopted in 1910. During part of World War I, from 1916 to 1917, he commanded the South African forces in East Africa. He was prime minister from 1919 to 1924. On the outbreak of World War II he succeeded General Hertzog for a second term as premier. In 1941 he was created a field marshal, and six years later received the Order of Merit.

Snails belong to the group of animals called *molluscs*. Thousands of species of snails live in the sea. Others inhabit fresh water or live on land. Some snails grow up to two feet long. In some countries people consider snails a delicacy to eat.

A snail has a single, coiled shell into which it can completely withdraw. The snail moves slowly on a single foot, with its head stretching out in front. The head has a mouth and a pair of 'horns'. At the end of the 'horns' are the snail's eyes. (See Mollusc.)

Snakes are legless reptiles closely related to lizards. Some lizards have no legs and look very much like snakes. But snakes differ from lizards in that they have no eyelids, no external ears, and deeply forked tongues.

A snake's body is covered with scales, making the skin valuable as leather for gloves, shoes and handbags. Its forked tongue is not used for biting or stinging, but for picking up particles from the ground and taking them into the mouth. The mouth contains cavities called *Jacobson's organ*, which are connected with the snake's sense of smell. In this way, the snake can smell its surroundings. Snakes have no external ears or eardrums and are deaf to sound waves. But they can sense vibrations in the ground, and thus know when something is approaching.

A snake's skeleton is made up of as

1. Some snakes, such as the anaconda, do not have fangs.

2. Some snakes, such as the boomslang, have small fangs at the back of the jaws.

3. The elapid snakes, such as the cobras, have rigid fangs at the front of the jaws.

4. The vipers have movable fangs at the front of the jaws. The fangs fold back when the mouth is shut.

many as 300 *vertebrae* (bones), to each of which is connected a pair of ribs. Because it has so many joints, a snake can bend its body easily. To move, it presses its body against the ground and bends from side to side. Snakes also swim with the same motion.

Snakes feed on animals ranging from insects to large mammals. Lizards and other snakes are a favourite prey, although a snake never attacks another snake of the same species. Some snakes render their victims helpless by coiling themselves around them and constricting them. Others bite, sometimes injecting poisonous venom into their prey through specially grooved teeth *(fangs)*. Snakes swallow their prey whole with the aid of long, curved teeth, and digest the meal at leisure.

Most snakes lay eggs, but some bear live young. The average number in a litter or clutch of eggs is 10, but the python may lay as many as 100 eggs. Snakes vary in length from about six inches up to 30 feet.

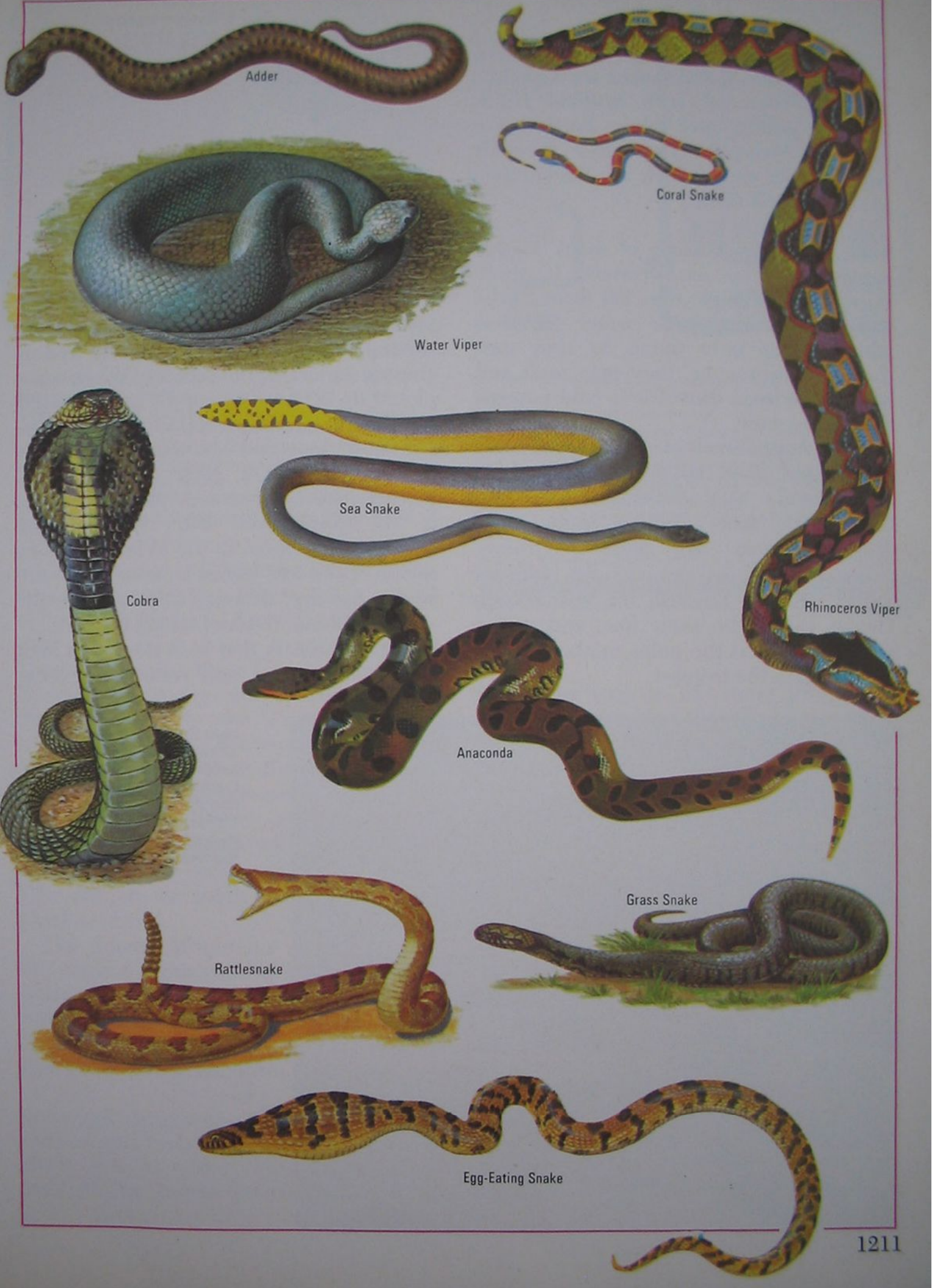
Snakes are cold-blooded creatures and they are most common in tropical regions, although they are not confined to such places. There are nearly 2,500 different kinds, or species, of snake and they are arranged in 10 families. Only about 250 kinds of snake have poisonous venom and only about half of these are dangerous to man.

The family *Colubridae* contains about two-thirds of all known snakes. They live in all continents except Australia and most of them are non-poisonous. They catch their food by snapping at it and gripping it in their mouths. If the prey struggles, the snake may well coil itself around the prey to prevent its escape, but the snake does not usually squeeze its prey. Colubrid snakes include water snakes, which live in rivers, lakes, or paddy fields, feeding on fishes or frogs, and tree snakes. Most tree snakes are mildly poisonous and feed on birds. Some tree snakes are *nocturnal* (active by night, resting by day). Well known European colubrid snakes include the grass snake, or ringed snake, and the smooth snake. Grass snakes often live in moist places such as swamps and ditches. They are good swimmers. An unusual colubrid snake is the egg-eating snake of Africa. It feeds almost entirely on birds' eggs, which it swallows whole.

The true constricting snakes are the boas of South America and the pythons of Africa and Asia. This group includes the largest snakes but they are quite primitive in some ways. For example, these snakes possess tiny remnants of hind legs which indicate that they descended from lizard-like ancestors. Boas and pythons are not poisonous. They coil their bodies round their victims and suffocate them by squeezing them until they cannot breathe. Many boas and pythons live in or near water. There is much argument about which is the longest snake. The two species in question are the anaconda (South America) and the reticulate python (India and Far East). The latter species has been known to swallow deer weighing more than 120 pounds. Both species of snake are known to exceed 28 feet in length but longer records have not been confirmed.

Among the really poisonous snakes there are the vipers, rattlesnakes, mambas, cobras, coral snakes, and the marine sea snakes. The vipers include the common adder. This snake is found throughout Europe, as far north as Finland, and it extends right across Asia to China. It has the widest distribution of any snake. The asp is another well known European viper, although the name is sometimes used for snakes in general. Cobras are found in Africa and Asia and are some of the most poisonous

Because their teeth are unsuitable for tearing or cutting, snakes swallow the bodies of their prey whole. Their jaws are joined by an elastic ligament which stretches and allows the jaw to be dislocated. This enables the snake to swallow surprisingly large victims.


Adder
Coral Snake
Water Viper
Sea Snake
Cobra
Rhinoceros Viper
Anaconda
Grass Snake
Rattlesnake
Egg-Eating Snake

of all snakes. They spread out a 'hood' behind the head and raise the front of the body up when they are disturbed and about to strike. Coral snakes are American animals, coloured with brilliant bands of red, yellow and blue. Rattlesnakes are also American. The 'rattle' is made up of horny rings which are the remains of old, cast-off skins.

Snow The upper parts of many clouds consist of tiny ice crystals. If these grow heavy enough, they fall through the clouds, colliding with water droplets which freeze onto them. As they pass through warmer air, they may melt and fall as raindrops. But if it is cold enough they fall as snow.

In the upper levels of clouds, ice crystals are shaped liked six-sided columns. At lower levels they develop into snowflakes with 'arms' and, as more cloud droplets freeze on, feathery fronds.

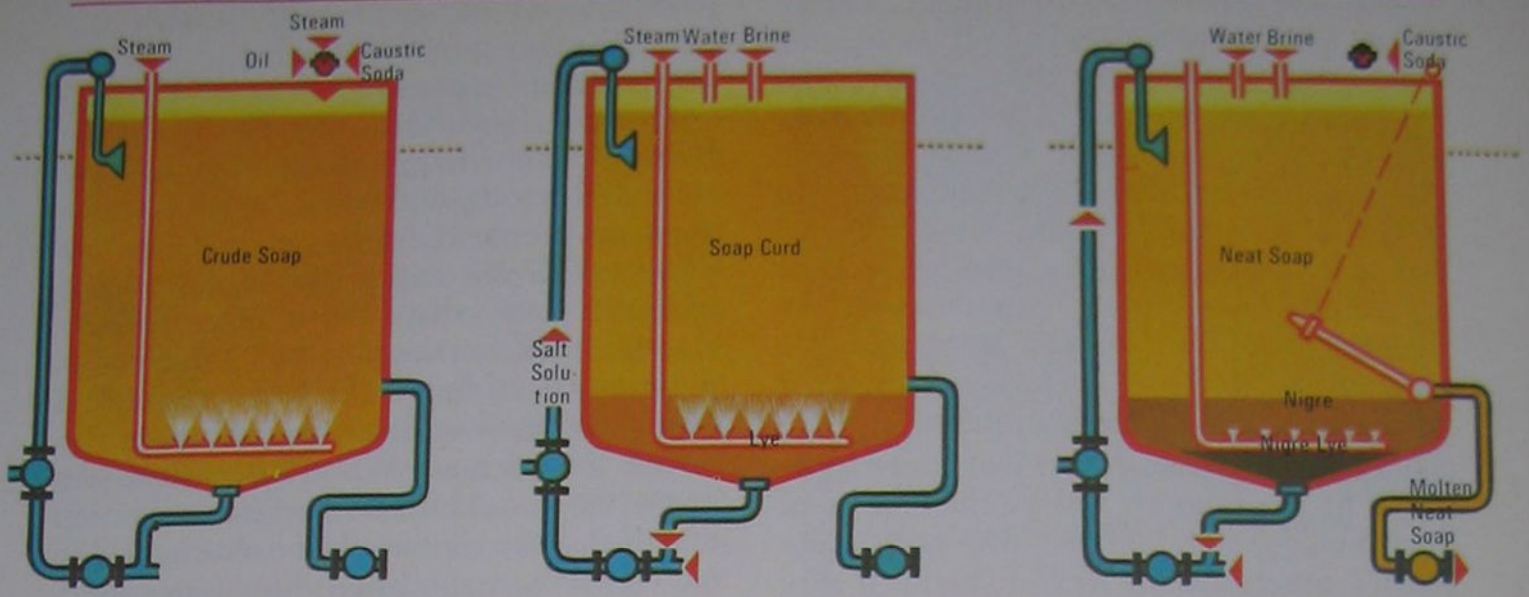
In mountainous regions snow is found above a certain level all the year round. This is called the *snow line*, and varies from sea level at the poles to about three miles high in the tropics.

Snow crystals grow in many beautiful shapes, but all are basically six-sided.

Snowy Mountains Scheme, in south-east Australia, is the country's largest hydro-electric and irrigation scheme. When completed in 1975, it will supply an estimated 4 million kilowatts of electricity to metropolitan Sydney and Melbourne, as well as to other parts of New South Wales, Victoria and Canberra. At the same time, it will supply free water for irrigating farms and pastures in the Western Plains region of the two states, an area where the land is too dry, although otherwise fertile.

The scheme involves taking the formerly unused waters that rush down the high Snowy Mountains and redirecting them

Lake Eucumbene, the main storage reservoir for the Snowy Mountains scheme. From here water is channelled through tunnels to the Tumut and the Swampy Plains rivers to irrigate the Western Plains.



Soap Making. Left: A charge of heated oil and concentrated alkali enters the vat and is mixed. Steam heats the mixture and *saponification* (the soap-making process) proceeds. Centre: When it is complete, fresh brine is added to precipitate the soap as a curd. A mixture of brine and glycerine, a valuable by-product, called *lye* sinks to the bottom of the vat. Right: The soap curd still contains salt, so it is boiled with water to remove it. A layer of neat soap forms, above layers of *nigre* (a thin salty fluid containing soap) and *nigre lye* (nigre containing some alkali and glycerine). The molten neat soap is run off from the vat.

Below: The soap molecule consists of a long chain of carbon and hydrogen atoms (black and white) with sodium and oxygen atoms (blue and red) at one end. This end is soluble in water and the other end in oil. In this way the molecules surround a grease particle and carry it into solution in water, giving a cleaning action.

into the Murray and Murrumbidgee rivers for use in irrigating about 1,000 square miles of the Murray-Murrumbidgee basin. One route takes water from the upper Murrumbidgee, the Tooma, and the Eucumbene rivers northwards through the mountains to the Tumut River, a tributary of the Murrumbidgee. The other takes water from the Snowy River westwards through the mountains to the Swampy Plain River, a tributary of the Murray. To take the water through the mountains, 100 miles of tunnels have been cut into the earth and rock and huge pipelines laid.

The Snowy Mountains Authority runs the project. Construction began in 1951. Besides power and irrigation works, the Authority has supervised the development of winter recreation sites, health resorts, and other tourist facilities in the region.

Soap and detergents We cannot get our clothes and body very clean by washing them just in water. The water simply rolls off the greasy dirt without 'wetting' it. Adding soap to the water produces a solution which does 'wet' and penetrate the dirt, and breaks it up into tiny particles or droplets. Soap surrounds these particles and floats them away in the water.

Soaps are made from animal fats and alkalis such as caustic soda and caustic potash. Caustic potash produces a milder soap. Fatty substances made from vegetable oils, such as cottonseed and coconut, are widely used instead of animal fats. The alkali and fats are boiled in huge vats to make the soap.

Soap is a *detergent*—that is, a substance that cleans. But we normally reserve this name for synthetic products which are much better cleaning agents than soap. Unlike soap, they do not form a messy scum in 'hard' water. They are made by treating petroleum by-products with sulphuric acid.

Social services In every human society there are people who cannot look after themselves – children, old people, the sick and cripples. In a simple society such people are either looked after by other members of their family or left to die. When a family looks after its own helpless members it gives them love, but it cannot give them expert care. So society has set up special institutions to care for the helpless, including homes for old people, schools and hospitals.

These early social services were provided by the Church and by the charity of better-off people. There are still huge charity organizations in the world. Every year millions of people give money to United Nations organizations like UNICEF, which cares for children all over the world. They also give money for cancer research, to help refugees, to relieve hunger in parts of the world where people are starving and for many other similar causes. But in the twentieth century more and more of this care for the helpless is done by government services.

There are two reasons for this. Private charity gives help to some kinds of need, but has neglected others. People who need help dislike receiving charity because too much charity has been patronising.

Money is paid to people who are out of work or who cannot work through sickness or because they are crippled. Medical help is given free or at a cheap rate. Schools are provided free. Special homes are provided for old people and for cripples. There are schools for the mentally deficient, for the blind, the deaf, and so on. Religious and private charity still plays a large part. For example, in Britain, a voluntary society builds homes for spastics. Meals are provided, in their homes, to old people in need and delivered by organizations such as the Women's Royal Voluntary Service.

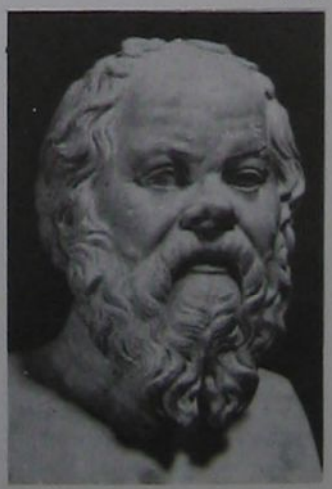
Socrates was a Greek philosopher who lived four hundred years before the birth of Christ. He wrote no books, and what is known to us of his life and thought has been handed down through the writings of his pupils, especially those of Plato.

Socrates believed that goodness is based on knowledge of the principles of right and wrong, and wickedness on ignorance of them. He did not believe that these principles are a matter of personal opinion, but that there are definite standards of human conduct which man must come to know. To help others find them out, he would ask questions such as 'What is courage?' When an answer was given he would describe a situation in which that answer would be wrong, and so on, until a man gave him the 'right' answer.

Because he forced men to think, Socrates gained many followers. But he also made some enemies among important people of the state. He was falsely accused of trying to bring a new religion to Athens, and thereby corrupt Greek youth. Found guilty, he was condemned to die.

The last thirty days of his life were spent in prison. During this time his friends planned an escape, but Socrates did not fear death and refused to break the law. His friends wept when his jailer brought him the traditional cup of hemlock, but Socrates drank the poison, dying as he lived, with calmness and dignity.

Sodium (Na) is one of the chemical elements. Its *compounds* (materials made of two or more substances), the most familiar of which is *sodium chloride* (common salt), are found in many parts of the world. They



A bust of Socrates in the Capitoline Museum, Rome. Socrates was a great philosopher who lived in Greece in the fifth century B.C. He was concerned that people should behave with goodness, basing their actions on wisdom.

are used in many commercial processes. Pure sodium is a silvery-white metal, so soft that it can be cut with a knife. Because it reacts so readily with other substances, it is never found uncombined in nature. Pure sodium has to be extracted by passing an electric current through one of its melted compounds. This was the method used by Humphry Davy when he first isolated the element in 1807.

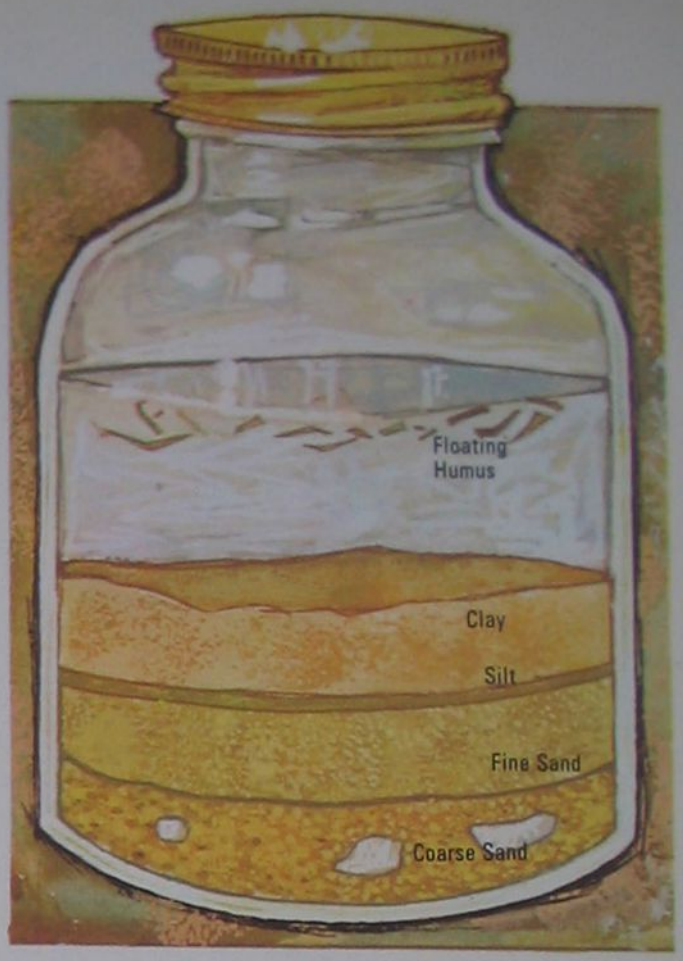
Besides salt, other sodium compounds in everyday use are *sodium carbonate* (washing soda) and *sodium borate* (borax) for laundering; *sodium bicarbonate* (baking soda) for cooking (and relieving indigestion); and *sodium hydroxide* (lye or caustic soda), a powerful alkali used for cleaning drains. Lye is also used in making soap, paper and cloth, and in refining oil.

Sofia (population 870,000) is the capital of Bulgaria and the country's leading trade, transport, cultural and manufacturing centre. Machinery, textiles, processed food and shoes are among its many products. Sofia is mostly a modern city. The cathedral, parliament and opera house are landmarks. Sofia was part of the Roman and Byzantine Empires. From A.D. 808 to 1018, it belonged to the kingdom of Bulgaria. Turkey captured the city in 1386. In 1878, Sofia became the capital of Bulgaria after Russia had liberated the country.

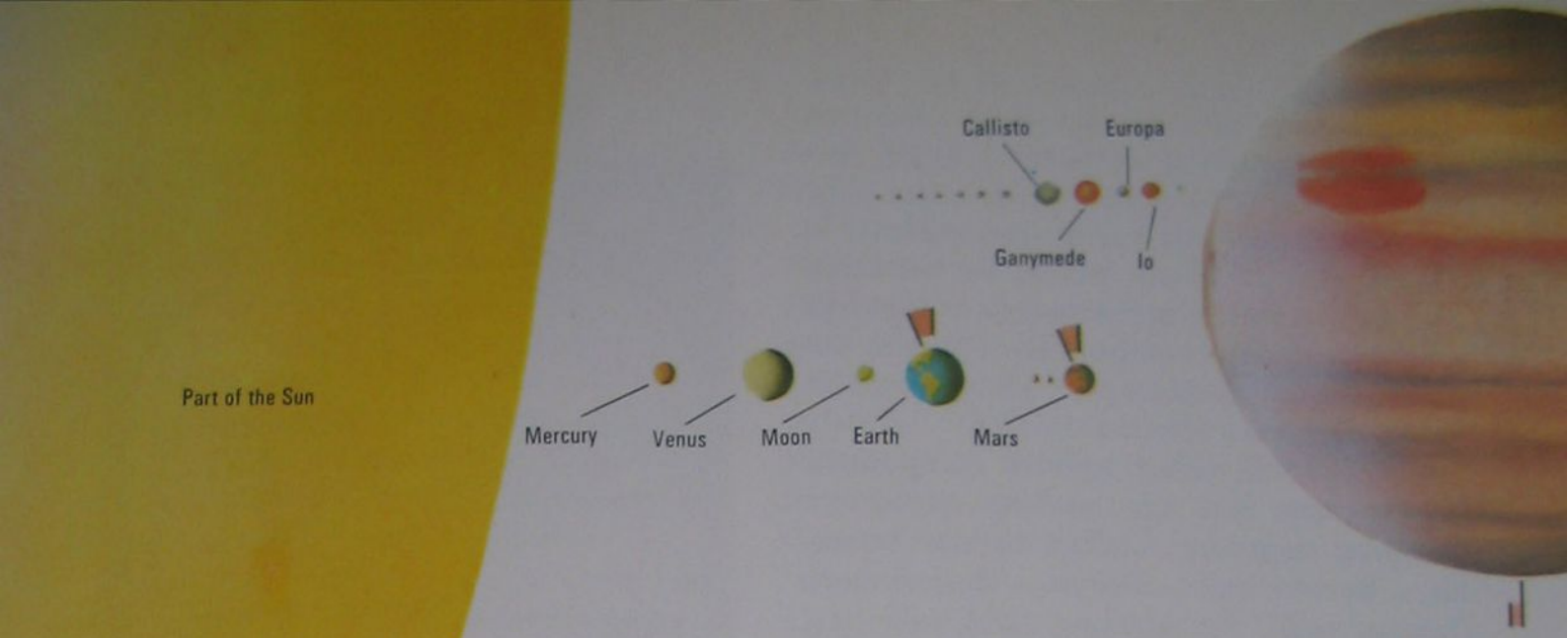
Soil is the layer of rather loose material which covers most of the rocks on the Earth. It consists mainly of fragments of rock. The rocks are constantly being broken down. The heat of the sun, freezing water, or even the roots of a tree can shatter rocks. Chemical changes may be brought about by rainwater and substances dissolved in it. These changes break down the rocks even further. The particles roll down hillsides, or they may be swept along by rivers, wind, or glaciers.

When these particles accumulate on the land surface, they form the *soil skeleton*. But it takes quite a long time for a layer of sand to become a soil. A few lichens and mosses, together with a few grasses perhaps, may be able to live on the bare particles. As these plants die, their remains add organic matter to the soil. This organic matter, formed from the decaying plants, is called *humus*. It is a vital constituent of soil because it is a jelly-like substance and it holds moisture and binds the soil particles into little groups. Not until the rock particles have acquired a fair amount of humus can they really be called soil.

There are several kinds of soil and their appearances depend mainly on the climate and the rocks from which they were formed. Sandy soils contain fairly large particles and large air spaces. They drain very easily—too easily for good gardening—and plant foods tend to get washed out



A soil sample can be analysed simply by shaking it up with water in a large jar. The heavy particles fall to the bottom first, and the proportion of different kinds of soil particles can be estimated roughly.



The Sun and the planets with their satellites are shown drawn to scale. The coloured bands indicate the angle at which the axis of a planet is tilted to the plane of its orbit around the Sun. On this scale, the Earth would be about 200 feet from the Sun and Pluto over 1½ miles away.

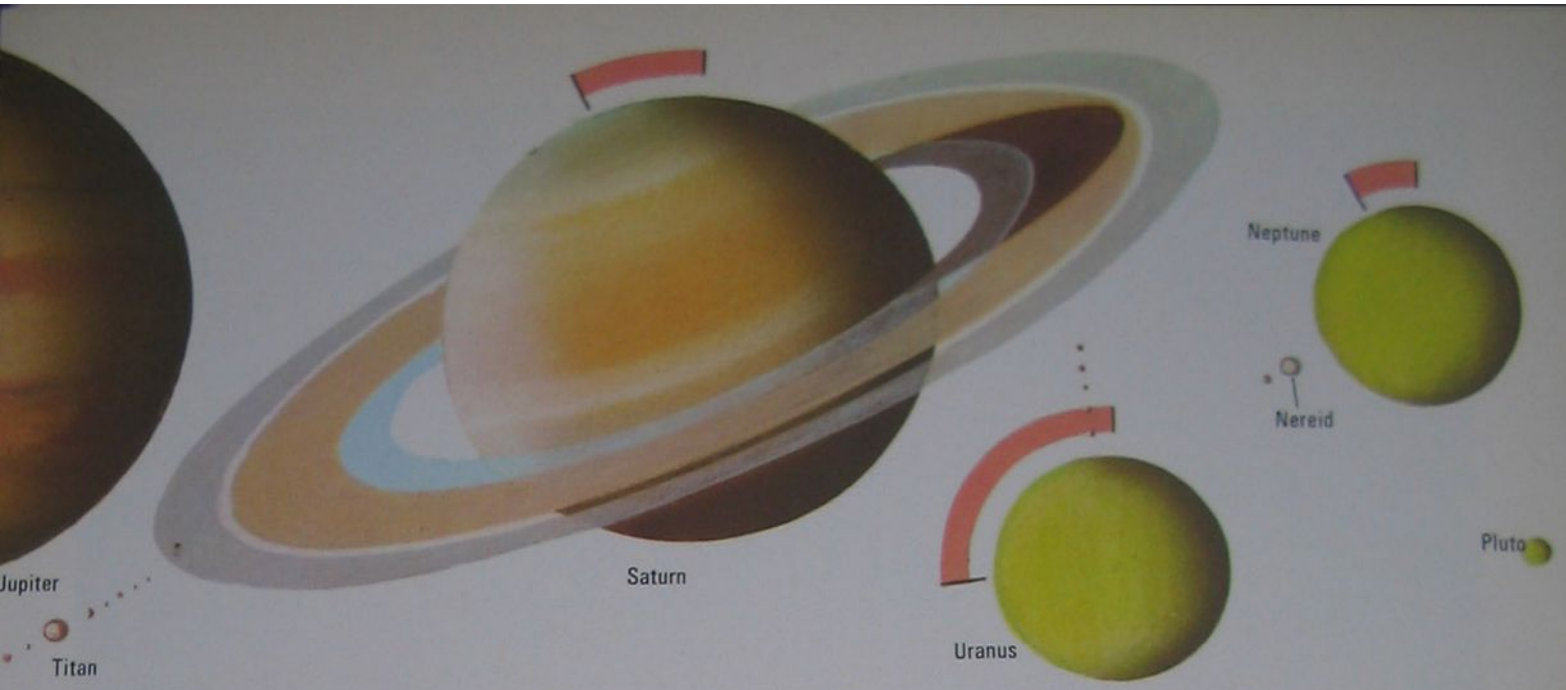
of the surface layers. Sandy soils are often called 'hungry soils' for this reason. Adding humus in the form of manure will improve a sandy soil. A clay soil is one composed mainly of minute particles of clay. These particles stick tightly together and the soil does not drain very well. It is hard to dig and is not very good for gardening, although it can be improved by digging in manure. The humus breaks the solid clay into 'crumbs'. The best gardening soil is *loam*, which is a mixture of sand and clay. It holds water but not too much. Manure must always be added to gardens and farmland to replace the humus used up by plants. Without it, the soil becomes dry and dusty. Fertilizers provide plant food but they do not provide humus for the soil.

Solar System The Solar System in which we live consists of the Sun, the planets and their satellites (moons), and the thousands of other smaller heavenly bodies, such as asteroids, comets, and meteors. The Sun is the centre of the Solar System. It holds together, by its force of gravity, all the bodies that revolve around it.

Only the Sun has any light of its own. The planets and moons shine by reflecting this light. The radius of the Solar System is more than 3,500 million miles, representing the distance from the Sun to the furthest known satellite member of the system, the planet Pluto. The nine planets, in order of their distance from the Sun, are Mercury (the smallest), Venus, Earth, Mars, Jupiter (the largest), Saturn, Uranus, Neptune, and Pluto.

The asteroids, or minor planets, circle the Sun just like the larger planets, but are nearly all grouped together between the orbits of Mars and Jupiter. About 2,000 of them are known.

The comets also circle the Sun, but



their orbits are very *elliptical* (oval), so that their distances from the Sun vary much more than those of the planets do. Some comets pass between the Sun and the Earth and then travel right out past Pluto.

It is unlikely that ours is the only such system in the Universe. There are probably many other stars with systems of planets.

There have been many theories attempting to explain the origin of the planets. One theory suggests that early in its life the Sun was surrounded by gases and solid particles. As these revolved with the Sun, separate masses of matter developed. These drew more particles to them, forming solid cores which slowly grew into the planets. There are other theories which suggest a sudden beginning rather than a gradual process. One such theory supposes that the Sun was once one of a pair of stars. Its partner exploded, throwing out matter, some of which was captured by the Sun's gravitational field and eventually formed the planets. The force of the explosion would have shot the remains of the other star into space.

Soldering is a method of joining metals together. An alloy called a *solder* is melted into the joint between the two metals. When the alloy cools, it sets hard and forms a firm joint.

A compound called a *flux* is added before or during soldering to clean the surfaces to be joined and to prevent the air getting to them. The solder will not form a firm joint if dirt and air are present.

Soft solders contain tin and lead and melt easily. They are widely used for joining electrical wires, sealing tin cans, and mending and joining pipes in plumbing. Resin is a common flux for soft solders.

Hard solders melt at high temperatures and form much stronger joints. Borax is often used as a flux. One kind of hard solder is silver solder, which contains silver, copper, and zinc. Brass is another hard solder. Soldering with brass is called *brazing*. The joints in bicycle frames are formed by brazing steel tubes together.

Somalia is a republic in eastern Africa. It occupies the part of the continent that juts out into the Indian Ocean in the shape of a horn. Bordering Somalia on the west are Kenya, Ethiopia and the French Territory of the Afars and Issas. The country's area is 246,202 square miles. Rocky deserts and semi-deserts cover much of

The location of Somalia in eastern Africa.

it. There are mountains in the north. Parts of the land are suitable for grazing animals and growing crops. The Juba and Webi Shebeli rivers in the south provide irrigation. The climate is always hot.

Somalia's 2,800,000 inhabitants are mainly Hamitic people, related to the Ethiopians. The largest city is Mogadiscio, the capital. Most Somalis live as *nomads* (wandering herdsmen). They keep livestock, such as camels, goats and sheep, for food and for the hides.

Somalia was inhabited in ancient times. The fragrant substances frankincense and myrrh that are mentioned in the Bible came from there. But the ancestors of many of the people who live there now probably came from Arabia in the 1200's. In the late 1800's Britain gained control of northern Somalia and Italy acquired the southern part. Both regions became independent and united in 1960.

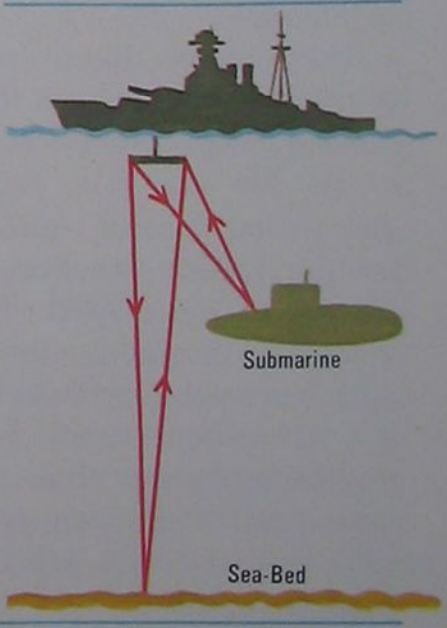
Somerset (area 1,613 square miles), a maritime county of south-western England, stands on the Bristol Channel in the north and north-west. Its county town is Taunton, and its population is 682,000.

There are two broad-upland areas—one in the west and south-west that includes the moorlands or Exmoor, the Blackdown Hills and the Quantock Hills—and the other the Mendip Hills in the north-east. The principal rivers are the Exe, Avon and Parret. Dairy farming is the main industry. Among the outstanding products are cheese and cider apples. Ponies roam the wilds of Exmoor, and some sheep are reared. The coastal resorts of Weston-super-Mare, Minehead and Burnham-on-Sea attract thousands of visitors, as do the historic towns of Wells and Bath.

Sonar is a device used for detecting the presence of submarines. It may be fitted to other submarines, surface ships, or dangled in the water from a helicopter. Sonar is also used for communicating with submerged submarines. The name *sonar* stands for SOund Navigation And Ranging. In Britain before the end of World War II, it was known as Asdic.

A version of sonar, called an echo sounder, is used for measuring the depth of the sea and for finding fish. In echo sounding, a transmitter sends sound waves down to the sea-bed. The sonar then measures the time taken for an echo to bounce back to the ship (see Echo). Because the sonar operator knows the speed of sound through water (about 4,800 feet a second) he can use the time measurement to work out the depth of the sea. He can detect a submarine or a shoal of fish because they will show a different depth.

Sonar is an echo-location device used to detect submarines. Ultrasonic signals emitted under a ship bounce off the submarine and the echo is detected by the ship, indicating the submarine's position. The depth of the sea-bed can be found in the same way.



Songbirds Millions of people find pleasure in listening to bird songs. But the songs usually have a practical purpose. They may warn other birds of danger, they

The nightingale is famous for its beautiful but rather sad song.

may mark off territory, or they may indicate anger. Sounds of this kind are known as *call notes*. The longer songs are part of the birds' mating rituals. Usually it is the male bird who sings.

Many songbirds, including nightingales, wrens, thrushes and mynahs, belong to the group called *oscines*. These birds have extra muscles in their throat that enable them to produce their wide ranges of sounds. In ordinary birds, the voice box has four pairs of muscles. In oscines, there may be up to eight pairs.

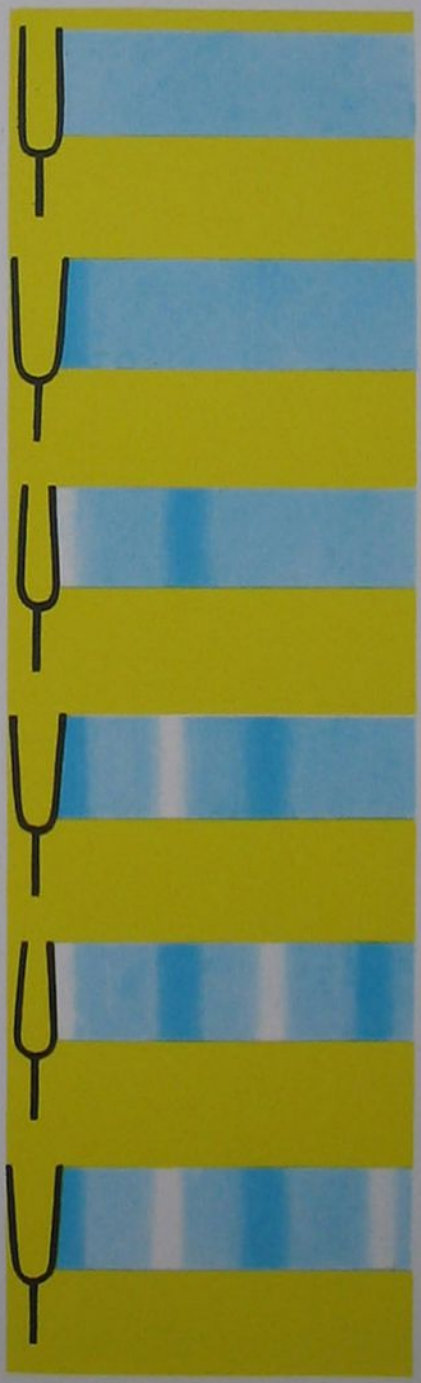
Songs are probably the oldest form of music, and organized songs were first performed in religious rituals. Religion has always inspired singing. Even today, most choral music is religious in character. The classical music of the last four hundred years grew out of the religious *plainsong* of the Middle Ages. In this field, singing reached a peak of achievement in the 1800's and early 1900's with the *lieder* and *song-cycles* of German composers, the *art songs* of French composers, and the great operas.

But ordinary people have always been singing about their lives, and handing down these *folk songs* from generation to generation. Every part of the world has developed its own kind of folk song, and the tradition is still alive in many countries. In the Middle Ages, minstrels wandered here and there, entertaining people with *popular songs* for a living.

Sophocles (about 496-406 B.C.), was one of the three great writers of Greek tragedy, along with Aeschylus and Euripides. Today, only seven of his plays survive, including *Oedipus Rex*, the most famous, and *Antigone*. But we know that he wrote more than 100. Sophocles's plays are notable for their strong plots, which pit the individual human soul against the forces of fate. Sophocles enlarged the size of the background chorus, added a third main character to his plays, and introduced other important changes in Greek drama. A rich man, born near Athens, Sophocles won many prizes for his plays.

Sound is energy in the form of *vibrations* which can be detected by the ears. These vibrations, which are movements to and fro of air, are called *sound waves*. They travel through the air and make the eardrums vibrate also. Nerves sense the eardrums' vibrations and send messages to the brain, and so we hear the sound. We need two ears to determine the direction the sound is coming from.

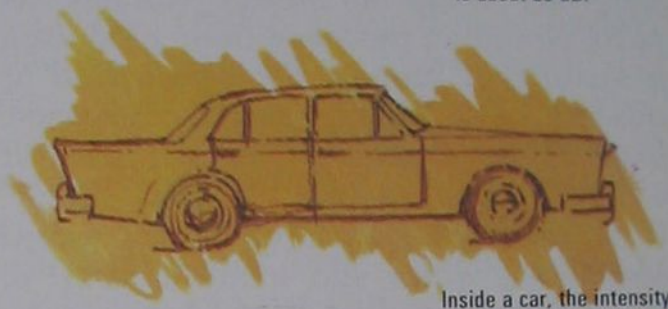
When an object such as a guitar string or door bell vibrates, we pick up the



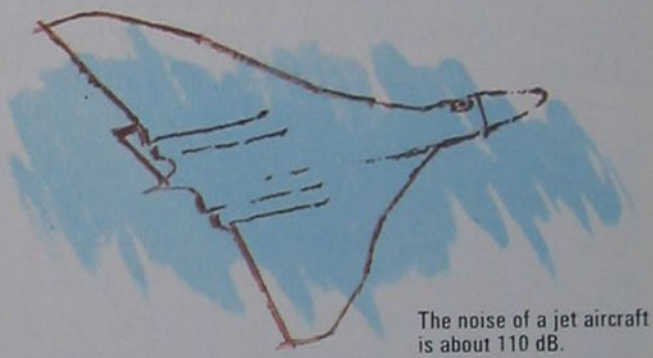
Sound waves are waves of pressure produced in the air when objects vibrate. When a tuning fork is struck, the prongs vibrate at a constant rate. As the prongs move outward, a zone of increased pressure (dark blue) is produced. This moves away from the fork as the prongs move inward, producing a zone of low pressure (white). A series of zones of high and low pressure are set up in the air, producing sound waves. The distance between each zone of high pressure is the *wave length*. The shorter the wave length, the higher in pitch the sound. The greater the pressure difference between zones, the louder the sound.

Above: A sound level meter measures the intensity of noise in decibels (dB). The upper knob selects the intensity region of the sound being measured. The lower knob *weights* the frequency range of the sound so that it approximates to that perceived by the human ear. The microphone is at the top of the instrument.

The sound of a whisper is about 20 dB.



Inside a car, the intensity of sound is about 50 dB.



The noise of a jet aircraft is about 110 dB.

Right: The intensities of three common sounds.

sound waves almost immediately. But if we watch a man chopping wood in the distance, we see the axe hit the wood before we hear the sound of the blow. This is because light travels faster than sound. Sound waves in air travel at about 1,120 feet per second. Sound travels faster through *denser* materials such as water and metal. Sound cannot travel at all in a vacuum because there is no *medium* (substance) to carry the vibrations.

We can tell one sound from another by its *pitch, loudness* and *quality*. The vibrations of a low pitched note are slower than those of a high note. The speed of the vibrations is called the *frequency*. Frequency is measured in *cycles per second*. The lowest notes we can hear have a frequency of about 20 cycles per second and the highest notes about 20,000 c.p.s. As people grow older their ears become less sensitive to high frequencies.

Loudness is the apparent intensity of sound which we hear. Noises may not sound equally loud to different people because people's ears are not equally sensitive. Sound *intensity* is measured in *decibels*. A sound of 0 decibels can scarcely be heard by a normal human ear. A sound of 140 decibels is so intense that it is painful.

The further away from the sound source you are, the quieter the sound will seem, because the energy decreases as it travels outwards. Sound waves produced by great

energy will have a large *amplitude*—that is, the vibration to and fro will be greater than if the sound were produced with little energy—and sound loud.

The quality of sounds differs because almost all noises are made up of more than one frequency. We hardly ever hear a pure note of a single frequency only. The 'pip' of the Greenwich time signal is a pure tone of 1,000 c.p.s. It is not such an interesting sound as that of a musical instrument or voice, or even a waterfall. When an object vibrates, its parts vibrate at the same time, producing a mixture of sounds. Each half, third or quarter of a cello string, for instance, may vibrate separately, giving notes at a higher pitch, though with less energy. It is these additional vibrations, called *harmonics,* which add to the interest of the sound and give it its characteristic tone quality. Noise is produced by an irregular mixture of vibrations; musical notes are regular, ordered vibrations.

The quality of a sound also depends on its surroundings. If you shout in the middle of an open space the sound waves travel outward, get weaker and die away quickly. If you are some distance from a large hard surface such as a wall or rock face your shout bounces back at you (see Echo). Your voice sounds different again in a large empty hall, where the sound waves bounce from wall to wall, and may take several seconds to die away. A room which produces this effect is said to be *reverberant.* In a hall full of people, curtains and soft furnishings, the sound waves are absorbed and die away quickly. You can alter the sound coming out of a large loudspeaker by standing in front of it. The sound will appear muffled because your body will absorb the high frequencies.

Both sound and light travel at a constant speed, but sound is much slower than light. This is why, in a storm, the peal of thunder normally follows a few seconds after the lightning flash.

As a train approaches, the pitch of its whistle appears to rise, and to fall again as the train roars away. This apparent change is called the *Doppler effect.* It is due to the crowding together of the sound waves as they come towards your ears and the stretching of the waves as the train passes. The pitch of the whistle itself does not alter.

South Africa lies at the southern end of the African continent. It has a pleasantly warm, sunny climate and magnificent scenery. It also has some huge national parks, where many kinds of wild animals are protected by law and can be seen roaming free.

Most of South Africa is a plateau surrounded by a narrow coastal plain. Some rugged mountain ranges, the Drakensberg Swartberg and Langeberg, rise from the plateau. The summer season between October and March is generally hot, with temperatures rising to about 90°F (32°C). Heavy rainfall occurs in the east. But three-quarters of South Africa has less than 25 inches of rain a year.

Four main groups of people live in South Africa. About a fifth are *Europeans* or *Whites,* who are of European descent. More than half of these are *Afrikaners* of Dutch descent. They speak Afrikaans, a language similar to Dutch. Most of the other Europeans are of British descent. They speak English. Europeans enjoy a high standard of living and control the country's government and economy. Many of the Europeans live in modern cities, including Johannesburg, Cape Town and Durban. Others own farms or work in the mining industry.

The *Africans,* also called the *Bantu,* make up about two-thirds of the population. Some of them live in special areas called *reserves,* where most of them are farmers. They live in mud huts and their main food is maize. Others work on European-owned farms or live in special areas called *townships* on the outskirts of the cities.

The *Coloureds* are people of mixed racial origin. They form about one-tenth of the population. A smaller group, the *Asians*, are descendants of labourers who worked on sugar plantations in the province of Natal in the 1800's.

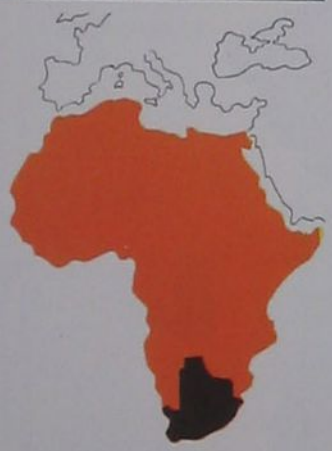
Four provinces form South Africa—Cape Province, Natal, Transvaal, and the Orange Free State. The country is a republic, with an elected president and parliament. Africans have no vote and are not represented in parliament.

South Africa is now an important industrial nation. About a million people work in factories, and textiles are an important export. The low rainfall over much of the country limits the area of farmland. Important farm products include fruit, hides and skins, maize and wool. South African mines produce diamonds, gold, uranium, and other minerals.

The first European settlement in South Africa was made by Jan van Riebeeck, a Dutchman, in 1652 on the present site of Cape Town. In the 1600's and 1700's, many Dutch people and other Europeans settled in South Africa. They fought wars against the African people. Britain seized the Cape in 1795 and again in 1806.

Facts and Figures
Area: 471,466 square miles.
Population: 21,447,000.
Capital: Cape Town (legislative); Pretoria (adminstrative).
Money Unit: rand.
Labour Force: 53% rural, 47% urban.
Exports: cattle, diamonds, foodstuffs, gold.
Imports: automobiles, chemicals, textiles.

In the 1800's, many British settlers went to South Africa. Many Dutch settlers, called *Boers*, resented British rule and so they began a long, hard journey to find new homes in the interior. This historic journey which began in 1836 is called the Great Trek. Conflict between the British and the Dutch led to the two Boer Wars of 1880-1881 and 1899-1902. Britain finally won and the various parts of the country were united in 1910 as the

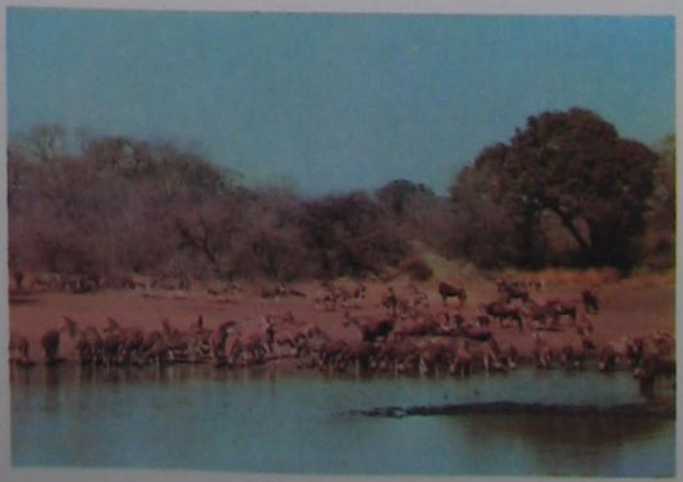


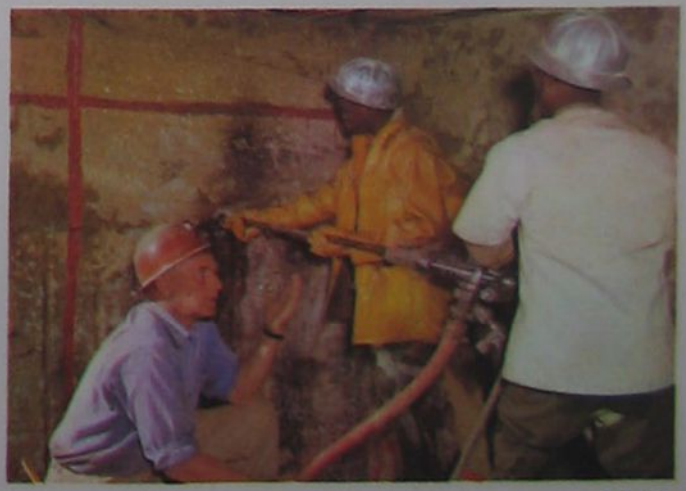
Left: Location Map of South Africa.

Below left: A herd of zebra at a waterhole in Kruger National Park.

Right: A view of Durban, a large city on the east coast of South Africa, in the province of Natal.

Below right: Gold miners receiving instruction in drilling at a training school.





independent Union of South Africa. In 1920, South Africa took over South-West Africa, a former German colony. South Africa became a republic in 1961.

In the late 1940's, the South African government began the policy of *apartheid*, an Afrikaans word meaning *apartness* or *separate development*. This policy aims at segregating the white and non-whites into separate areas.

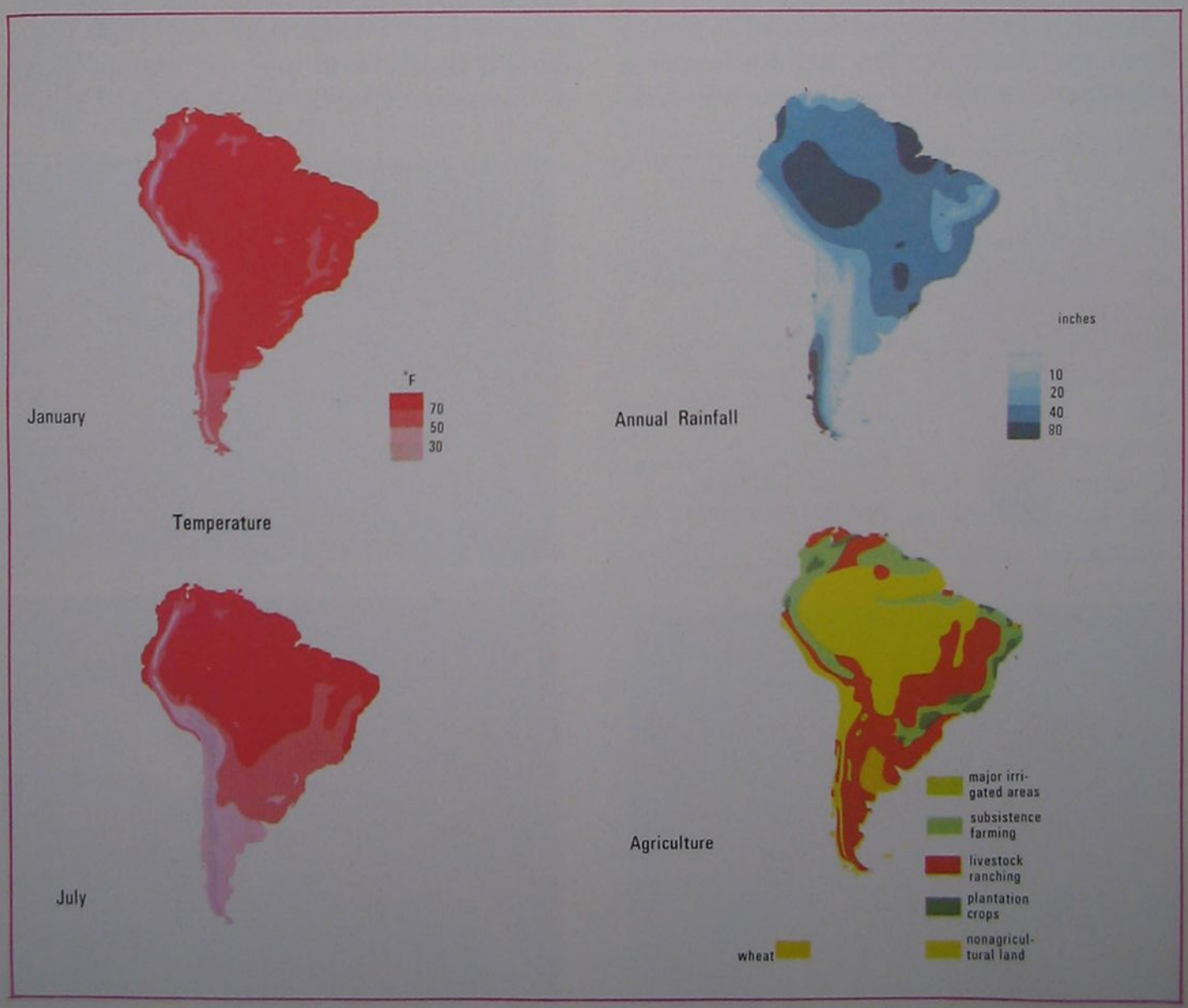
South America is the fourth largest continent, covering 14 per cent of the Earth's land area. It is almost twice the size of the United States, but is sparsely populated.

South America is joined to Central and North America by the Isthmus of Panama, and lies almost entirely to the east of them.

The land can be divided into three main regions running north and south: in the west, the Andes, running parallel to the Pacific coastline; in the centre, the great central plains, stretching from the Orinoco Basin to Patagonia; and in the east, the eastern highlands.

The Andes rise to more than 20,000 feet in places, and stretch from Panama to Tierra del Fuego in the south. Many important rivers, including the Amazon, start in the foothills of the Andes mountains.

The plains in the central regions go by various names, according to their latitude. In the north, on the borders of the Guianas and Brazil, they form the *llanos*. The Brazilian jungles are called *selvas*. Farther south, the *Gran Chaco*, comprising hundreds of thousands of square miles of grasslands, swamps and lakes,



South America: A physical map
CARIBBEAN SEA
ATLANTIC OCEAN
PACIFIC OCEAN
VENEZUELA
COLOMBIA
ECUADOR
PERU
BOLIVIA
PARAGUAY
BRAZIL
CHILE
ARGENTINA
URUGUAY
FALKLAND ISLANDS
Caracas
Georgetown
Paramaribo
Cayenne
Bogota
Quito
Guayaquil
Lima
Chiclayo
Huanuco
Iquitos
Porto Velho
Rio Branco
Manaus
Belem
Sao Luis
Teresina
Fortaleza
Recife
Salvador
Brasilia
Goias
Belo Horizonte
Rio de Janeiro
Sao Paulo
Santos
Curitiba
Porto Alegre
La Paz
Cochabamba
Sucre
Potosi
Arequipa
Ica
Iquique
Antofagasta
Corumba
Asuncion
Villarrica
Encarnacion
Tucuman
Cordoba
Santa Fe
Rosario
Paysandu
Montevideo
Buenos Aires
Mendoza
Valparaiso
Santiago
Concepcion
Temuco
Bahia Blanca
Comodoro Rivadavia
Punta Arenas
Tierra del Fuego
Cape Horn
MATO GROSSO
BRAZILIAN HIGHLANDS
GRAN CHACO
ATACAMA DESERT
ANDES MOUNTAINS
PATAGONIA
PAMPAS
Amazon
Madeira
Tapajos
Xingu
Araguaia
Tocantins
Sao Francisco
Paraguay
Parana
Pilcomayo
Salado
Colorado
Uruguay
Rio de la Plata
10°N
Equator
10°S
Tropic of Capricorn
30°S
50°S
80°W
60°W
40°W
Temperate Forest
Tropical Forest
Equatorial Rain Forest
Grass
Savannah
Hot Desert
Temperate Desert
Tundra and Ice Caps
Mountain Vegetation
0
200
400
600
800
1000
Miles

COUNTRIES OF SOUTH AMERICA

Country	Area in sq. mi.	Population	Capital
Argentina	1,072,070	24,300,000	Buenos Aires
Bolivia	424,163	4,931,000	La Paz
Brazil	3,286,478	93,000,000	Brasília
Chile	286,397	8,834,000	Santiago
Colombia	439,513	21,792,000	Bogotá
Ecuador	104,506	6,194,000	Quito
French Guiana	35,135	48,000	Cayenne
Guyana	83,000	714,000	Georgetown
Paraguay	157,047	2,396,000	Asunción
Peru	496,223	13,600,000	Lima
Surinam	53,143	480,000	Paramaribo
Uruguay	72,172	2,500,000	Montevideo
Venezuela	352,143	10,778,000	Caracas

stretches across parts of Bolivia, Paraguay, and Argentina. From the Gran Chaco to Patagonia in the far south are the *pampas*, the farming and grazing lands from which Argentina gets most of its wealth.

The eastern highlands are much lower than the Andes. They consist of the Guiana Highlands, the Brazilian Highlands and the Patagonian Plateau.

South America's river system is dominated in the north by the immense Amazon basin. In the north-west, the rivers Magdalena and Cauca join in the north of Colombia and empty into the Caribbean Sea. The Orinoco, fed by more than 400 tributaries, flows through the middle of Venezuela into the Atlantic Ocean. The eastern Brazilian Highlands are drained by the 1,800-mile-long São Francisco that also flows into the Atlantic. The most important waterway system in South America is the Río de la Plata. This is a broad estuary formed by the rivers Paraná, Paraguay, and Uruguay. It serves Argentina, Brazil, Bolivia, Paraguay and Uruguay.

Most of South America lies within the tropics, and its climate is generally warm and sunny throughout the year. Seasonal extremes of temperature are not as great as they are in parts of Asia and North America. In the Brazilian jungles, on the Equator, it is always hot and humid. High in the Andes the snow never melts. In the south, summers (December to March) are cool, and winters (June to September) are mild. The heaviest rainfall (more than 60 inches a year) occurs in the Amazon valley, the coasts of the Guianas, Colombia and Ecuador, and in south-western Chile. But strips of northern Chile and Peru, and Patagonia get practically no rainfall, and are virtually deserts. The icy Peru Current of the Pacific Ocean swirls along the coasts of Chile and Peru and keeps them cool.

Although about a quarter of all the world's known animals live in South America, there are no large herds of game such as are found in North America and Africa. Most of the animals are found in the rain forests of the Amazon Basin. There are no very large animals to rival the elephant and giraffe. The largest animal in South America is the tapir, which is about the size of a small pony. The anaconda is one of the world's largest snakes, and the piranha probably the most ferocious fish. Sloths, armadillos and giant anteaters are all unique to the continent. Birds are particularly abundant and colourful, ranging in size from gem-like hummingbirds the size of a bumble-bee, to the giant condor, with its 10-foot wing span.

Some 2,500 kinds of trees flourish in South America's rain forests, and the list of orchids is almost endless. Some of the most valuable woods are *quebracho*, the hardest timber in the world; *cinchona*, whose bark yields the quinine which is used in fighting the disease malaria, and *balsa*, one of the lightest woods in the world.

There are 11 independent countries in South America. The largest is Brazil. Surinam (an overseas territory of the Netherlands) and French Guiana (an overseas department of France) occupy the north-east coast of the continent. The people of all these countries speak Spanish except for those of Brazil (Portuguese), Guyana (English), French Guiana (French), and Surinam (Dutch).

More than half the people of South America are farmers, but there is still an

enormous amount of land that is unused or used wastefully. In some countries there are millions of people living in poverty, while a comparatively small number of wealthy families live in luxury. But many South American governments are beginning to break up the large estates and trying to share their countries' wealth more fairly.

Although manufacturing is growing rapidly, many manufactured articles have still to be imported. Exports are mainly agricultural: coffee, beef, cotton, sugar, cereals, bananas and wool.

South America is part of a larger cultural region called *Latin America*. This includes nearly all of Central America, Mexico, some Caribbean islands, and the whole of South America, with the exception of Surinam and French Guiana.

Latin America was originally discovered and explored by Spanish and Portuguese explorers in the 1500's. In the early 1800's most countries, inspired by the Venezuelan general, Simón Bolívar, fought for and achieved their freedom from colonial rule. The following 100 years were years of revolution and bloodshed. Today, the continent is outwardly peaceful, but a number of countries lie uneasily under military dictatorships.

Top: Gauchos at Montevideo, Uruguay.

Above: Llamas are related to camels. South America has many strange and unusual animals.

Left: An Indian girl.

Below: The *Carnaval* at Rio de Janeiro, Brazil, is a world-famous event, held every year before Ash Wednesday. People dress up and dance and sing in the streets.

South Australia is a state in the central part of Australia's southern coast. Its area of 380,070 square miles is the third largest among the states, while its population of 1,177,800 is the fourth largest.

Bordering the state are Western Australia on the west, Northern Territory on the north, Queensland on the north and east, and New South Wales and Victoria on the east. On the south, it has a long coastline on the Indian Ocean. Adelaide, the state capital, largest city and main port, lies on Gulf St. Vincent.

The climate in the northern four-fifths of the state is always hot and dry. The average annual rainfall is less than 10 inches, and some areas (around Lake Eyre, for example) receive no rain at all for

Most of South Australia has less than 10 inches of rain a year. In the north-east of the state the Great Artesian Basin provides essential water supplies at water holes like this.

years at a time. The plateau in the north-western part of the state is a huge desert. Other wasteland areas include plains in the south-west (the Eucla Basin), swampy areas and salt lakes. The north-east, though dry, can support some cattle because of its underground water supplies. It is part of Australia's *Great Artesian Basin* (a huge body of water trapped between rocks underground).

The southern part of the state has a climate similar to the Mediterranean region of Europe and is far better suited to agriculture. Summers are hot and dry, but winters are moist. Many farms are located in the Murray River Basin in the south-east.

Today, South Australia depends chiefly upon industry for its economic welfare. Adelaide, where more than 60 out of every 100 people in the state live, is the heart of the manufacturing district. South Australia's factories produce large numbers of cars, heavy transport vehicles, ships, cotton goods and chemicals.

Metal industries depend upon ores from inside and outside the state. High quality iron ores from the Middleback Range is smelted in Whyalla.

South Australia's farms produce a large proportion of the country's wheat, barley and animal foodstuffs. Its vineyards yield enough grapes to make about three-quarters of Australia's wine. A wide variety of fruits and vegetables grow in the irrigated Murray River valley. South Australia's farmers also rear dairy cows (principally around Adelaide). Large numbers of sheep are kept for their wool.

Plans for settlement of South Australia

A location map of South Australia.

began in the 1820's, but were not carried out until 1836, when the colony was established. The early years were very difficult ones for the colonists because of lack of financial support from the British government, land speculation by a few greedy people and unemployment. But by 1844, the colony had begun to pay its way. Twelve years later it became self-governing. In 1863, the British government gave South Australia control of the Northern Territory. This arrangement lasted until 1911, when the federal government took control of the territory.

South Carolina is a southern state on the Atlantic coast of the United States. It covers an area of 31,055 square miles. About two-thirds of it is 'low country', extending inland from salt-water marshes along the shore. In the north-west is the more hilly 'up country'. Columbia, the state capital, is in the centre of the state. Charleston is a leading city and port and has elegant old mansions and beautiful gardens, with an air of pre-Civil War days. South Carolina's population is 2,591,000.

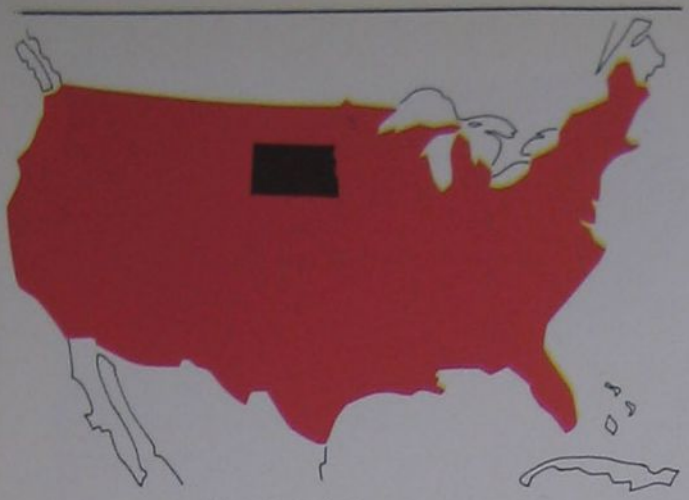
The location of South Carolina.

The manufacture of textiles is the state's most important industry. Chemicals and paper are also manufactured. Farmers grow tobacco, cotton and peaches.

In 1719, South Carolina became an English colony, one of the original thirteen. Important battles of the War of Independence were fought on its soil. In 1861, the first shots of the Civil War were fired in South Carolina.

South Dakota, in the Midwest region, is one of the leading agricultural states of the United States. Of the population of 666,000, only about 45 out of every 100

The mansion at Boone Hall Plantation near Charleston is typical of southern architecture of pre-Civil War days.



A location map of South Dakota.

live in cities such as Pierre (the capital), Sioux Falls and Rapid City. Ranchers rear sheep and beef cattle, and some dairy cattle and pigs are also reared. Farmers grow large quantities of maize, wheat, oats, barley and flaxseed.

South Dakota covers an area of 77,047 square miles. Its varied landscape, with its many examples of Indian life and relics of the Old West make tourism the second most important industry after farming. The famous Mount Rushmore National Memorial is in the Black Hills in the south-west.

The United States bought the South Dakota region from France in 1803. In 1889, South Dakota became the 39th state.

South-East Asia is a name often used to describe the mainly tropical area between India, China and Australia. It includes Burma, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand (Siam), Vietnam and several smaller territories.

Most of South-East Asia's peoples are brown-skinned with Mongoloid eyes. On mainland South-East Asia, most people are Buddhists. In Malaya and Indonesia, Islam is the main religion. In the Philippines, most people are Roman Catholics.

South-East Asia is the greatest rubber-producing area in the world. It also produces many minerals, including jewels. Rice is the main food crop. Teak and other valuable timber is exported. A great variety of animals live in thick forests.

India and China dominated the early culture of the area. Arab and Muslim influence over the islands was extended between 1300-1600. The Portuguese, Spaniards, Dutch, British and French took all the area except Siam (Thailand) by 1900. Japan seized the whole area in 1941-45. By 1963 no colonial territories remained in the area.

Indonesia expelled the Dutch by war by 1949, and Vietnam expelled the French by 1954. But independence did not bring peace.

During the 1960's and 70's many of the countries of South-East Asia were plunged into civil war when Communist forces tried to take over from elected governments. The worst of these wars was in South Vietnam. The United States and North Vietnam both joined in on the sides of the South Vietnamese government and the Viet Cong Communist guerrillas respectively. A cease-fire was agreed between the combatants in January 1973. Fighting also took place in Cambodia, Laos, Indonesia and Malaya.

Southern Alps are the principal mountain range of New Zealand. They form a backbone, about 200 miles long, running parallel to the west coast of the South Island. Other ranges to the north and south complete a mountain system that extends the entire length of the island. The Southern Alps form a natural boundary between the provinces of Westland and Canterbury.

The peaks of the Southern Alps are high and jagged, with few passes through them. They generally reach 8,000 feet in height, but many are more than 10,000 feet high. Mount Cook (12,349 ft), in the central part of the range, is the country's highest point. This and other peaks are covered with ice and snow throughout the year. In some places, the ice, moves slowly down the mountainsides in immense *glaciers*. The largest of these is the Tas-

man Glacier which is 18 miles long and more than a mile wide.

The Southern Alps attract many holidaymakers to the area for winter sports.

Southern Yemen *see* Yemen.

Southland, at the southern end of the South Island of New Zealand, is a subprovince of Otago. It has an area of 11,400 square miles, and a population of 100,390. Invercargill is the largest and most important town.

The main rivers, all flowing southwards into the Foveaux Strait, are the Waiau, Aparima, Oreti and Mataura. To the west of the Waiau lies the sparsely populated, mountainous region of Fiordland. There are a number of beautiful lakes, including Te Anau, Manapouri, Hauroko and Poteriteri. To the east of the Waiau there are cultivated plains, crossed by the Honokui Mountains.

Farming is the main industry of Southland, with sheep and cattle providing mutton, lamb, wool, beef and dairy products. Wheat is the principal crop. Fishing is important; the local waters yielding oysters and crayfish in abundance.

South Pole This is the southern end of the Earth's axis, located on an ice-cap 10,000 feet above sea-level. It is colder than the North Pole, partly because of its altitude, and partly because it is remote from the sea.

Captain James Cook, the British naval explorer, was first to cross the Antarctic circle in 1773. The first landing on the mainland was probably made by an American sealer in 1821. In January 1912 Captain Robert Scott reached the South Pole but found that Norwegians led by Roald Amundsen had been there five weeks earlier. (See Amundsen.)

In 1929 the United States explorer, Commander Richard E. Byrd, flew over the South Pole from his base at Little America on the Ross Sea. Since World War II there have been many expeditions, notably one by the U.S. Navy in 1946-7. In International Geophysical Year (1957-8), many expeditions studied Antarctic conditions. The United States has a permanent scientific base at the South Pole.

A Commonwealth expedition, led by Sir Vivian Fuchs, was the first to cross Antarctica via the South Pole in 1958.

To the west of the Waiau River in Southland, New Zealand, is the heavily wooded and sparsely populated region of Fiordland.

South-West Africa is a territory on the south-west coast of Africa, bordered by Angola, Zambia, Botswana and South Africa. It covers an area of 318,261 square miles, and has 615,000 inhabitants. Most are African tribesmen. Windhoek is the capital.

South-West Africa's climate is hot and dry, and most of the land is too poor for farming. Farmers rear some beef cattle, goats and sheep (for Persian lamb wool). Diamonds, found in the Orange River bed and on the Atlantic shore, are the main export.

Germany established the colony of South-West Africa in 1884, then lost it to South Africa during World War I. The League of Nations granted South Africa a mandate to rule the territory in 1920. The U.N. attempted to end this in 1966, but South Africa refused to comply.

Space probes Since 1959, Russian and American space scientists have been sending spacecraft both to the Moon and to the planets to find out more about them. These spacecraft are called *probes*.

Space probes carry instruments to measure such things as radiation and magnetism and to take photographs. They also carry radio transmitters to send information back to scientists on Earth. The information is generally stored in a tape-recorder in the probe and transmitted back to Earth upon command. This measuring and sending back information from a distance is called *telemetry*.

Power for the instruments comes from devices which produce electricity from sunlight. The sunlight is collected by a number of tiny *solar cells* on long, flat 'wings' which extend from the spacecraft.

Aiming a probe is a difficult task because the target—the planets or the Moon—is moving in space. The probes must therefore be aimed to reach a point in space at the same time as the Moon or planet does.

Most probes have been directed at the Moon—our nearest neighbour in space—to prepare the way for man to land there. These lunar probes photographed possible landing sites and sent back information about the surface.

Early lunar probes, such as Lunik and Ranger craft, merely crashed on the Moon. Later probes went into low orbit and photographed the surface at close

Left: A view of mountains on the Moon transmitted by Surveyor 7 in 1968. Below: The eleventh of the historic series of 21 pictures of the surface of Mars taken by Mariner 4 in July 1965, and beamed over 135 million miles back to Earth.

range. In 1966, Luna and Surveyor craft made soft landings on the Moon, and found the surface to be hard.

To make a soft landing, a probe must be slowed down before it hits the surface. This is done by firing retro-rockets beneath it all the way down. There is no atmosphere on the Moon to help slow the craft down. Sprung feet on the craft absorb the final shock of landing. These lunar probes paved the way for the historic landing on the Moon by American astronauts in July 1969.

Several probes have also been sent to Mars and Venus, the two planets closest to the Earth.

Spain is a country in south-western Europe. With its neighbour Portugal, it occupies an area called the Iberian Peninsula. Spain's northern border with France and Andorra passes through the Pyrenees, a mountain range. Eastern Spain faces the Mediterranean Sea. The Atlantic Ocean lies to the south-west and north-west, and the Bay of Biscay to the north.

Madrid, the capital, lies in the centre of Spain on a mountainous plateau that covers about three-quarters of the country. Much of the plateau is bare, infertile land. The coastal plains provide much rich farmland in areas with sufficient water. Spain has several mountain ranges which run from west to east.

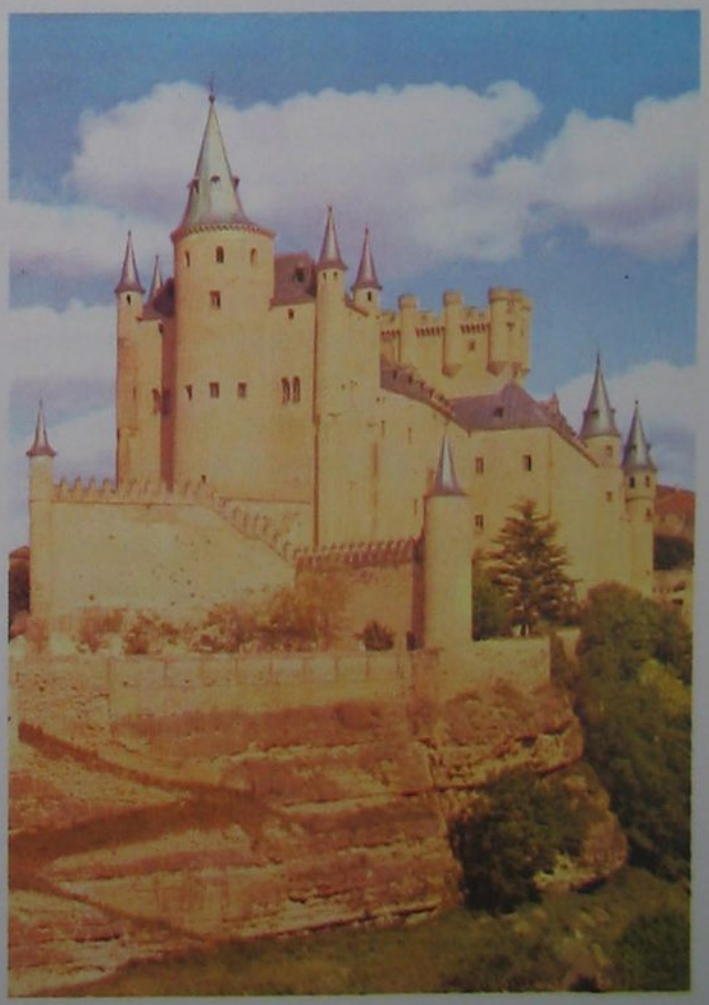
Northern Spain has wet winters and cool summers. This area is used for growing maize and rearing cattle and goats. Less rain falls on the plateau and the summers are hot and dry. The weather can change very quickly on the plateau. A burning hot day is often followed by a freezing cold night. The south and east coasts enjoy mild winters and hot summers.

The warm dry climate of the Mediterranean coast of Spain has led to its development as the most popular tourist area in Europe. From the French border to Gibraltar the coast is almost continually built up wherever there are suitable beaches. Small fishing villages such as

Above: People dress up and decorate the streets for the fair that takes place every April in Seville in southern Spain.

Right: Location Map of Spain.

Below: The Alcazar is a medieval castle standing on a hill in Segovia. It was built in 1358.



Facts and Figures
Area: 194,884 square miles.
Population: 33,609,000.
Capital: Madrid.
Money Unit: peseta.
Labour Force: 65% rural, 35% urban.
Exports: foodstuffs, manufactures, tobacco.
Imports: foodstuffs, fuels and lubricants, manufactures, oils and fats.

Benidorm, have doubled their original size many times and are now international resorts. Nearly 25 million tourists visited Spain in 1970 and spent about 700 million pounds sterling. Tourism has provided work for many Spaniards and has improved the standard of living. But it has caused prices to rise and the Mediterranean coast has been built up with little consideration for the environment.

About half of the people work on farms. They grow almonds, chestnuts, grapes, oranges, tobacco, lemons and wheat. The Spaniards make large quantities of wine from the grapes. Spain's most famous wine is sherry. Olive groves cover much of the hilly country, and olive oil is an important export. Forests of Spanish chestnuts and cork oak flourish in the northern mountains, but few trees grow in central Spain. Coal, iron ore, mercury, pyrites and salt are mined. Factory products include lace, cotton, silk and woollen goods, wine, glass and articles made from cork.

Most Spaniards live in small towns or villages. The official language of the country is Spanish. But three regional languages are spoken—Basque, Catalan and Galician. Nearly all Spaniards are Roman Catholics.

Spain was conquered by the Moors in the 700's. By the 1200's, most of Spain had been retaken by the Christians. In the 1500's, Spain took much of Central and South America and ruled it until the 1800's.

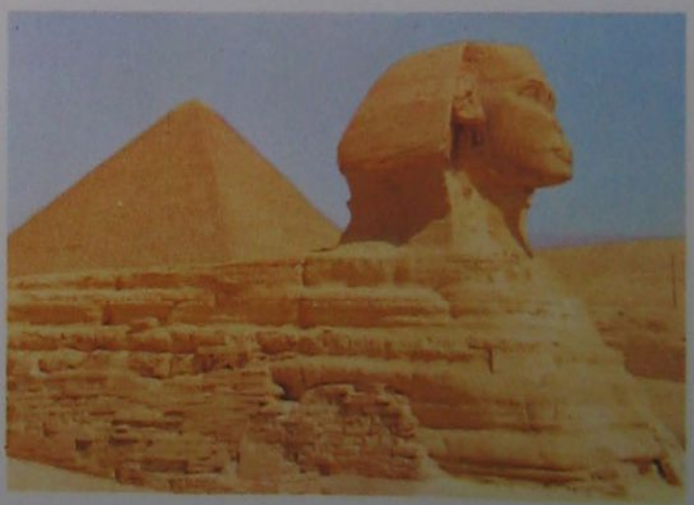
Spain became a republic in 1931. A military rebellion against the republican government in 1936 led to the terrible Spanish Civil War. Nearly a million people died in the war which ended in 1939. General Francisco Franco, leader of the rebels became dictator. Spain stayed neutral in World War II. In 1973 Franco was still *caudillo* (leader) at the age of 80. Although there is an elected parliament, Spain is still, in effect, a dictatorship. Franco has nominated Prince Juan Carlos, the heir to the Spanish throne, as his successor.

Speed is the measure of how fast an object is travelling. It is stated in such units as *feet per second* or *miles per hour*. The unit tells how much distance is covered in how much time. Seamen measure the speed of a ship in *knots*. A knot is one nautical mile per hour. A nautical mile is longer than a land mile. The word *velocity* has a similar meaning to the word *speed*. Velocity is speed in a given direction.

The speed of a vehicle is measured by an instrument called a speedometer. A car speedometer works by means of a revolving magnet connected to the wheels. A ship or aeroplane speedometer works on the principle of water or air resistance. As the craft's speed increases, the resistance becomes greater. In measuring the speed of a spacecraft, electronic signals are used.

Sphinx The Giant Sphinx of Giza, in Egypt, is a mythical beast. Several kinds of sphinxes were known from Greece to China. It seems to have been regarded by the Ancient Egyptians as a form of the Sun

The Giant Sphinx is a huge monument at Giza in Egypt. Carved from solid rock, it is 240 feet long and 66 feet high. Desert sands have worn away part of the body.



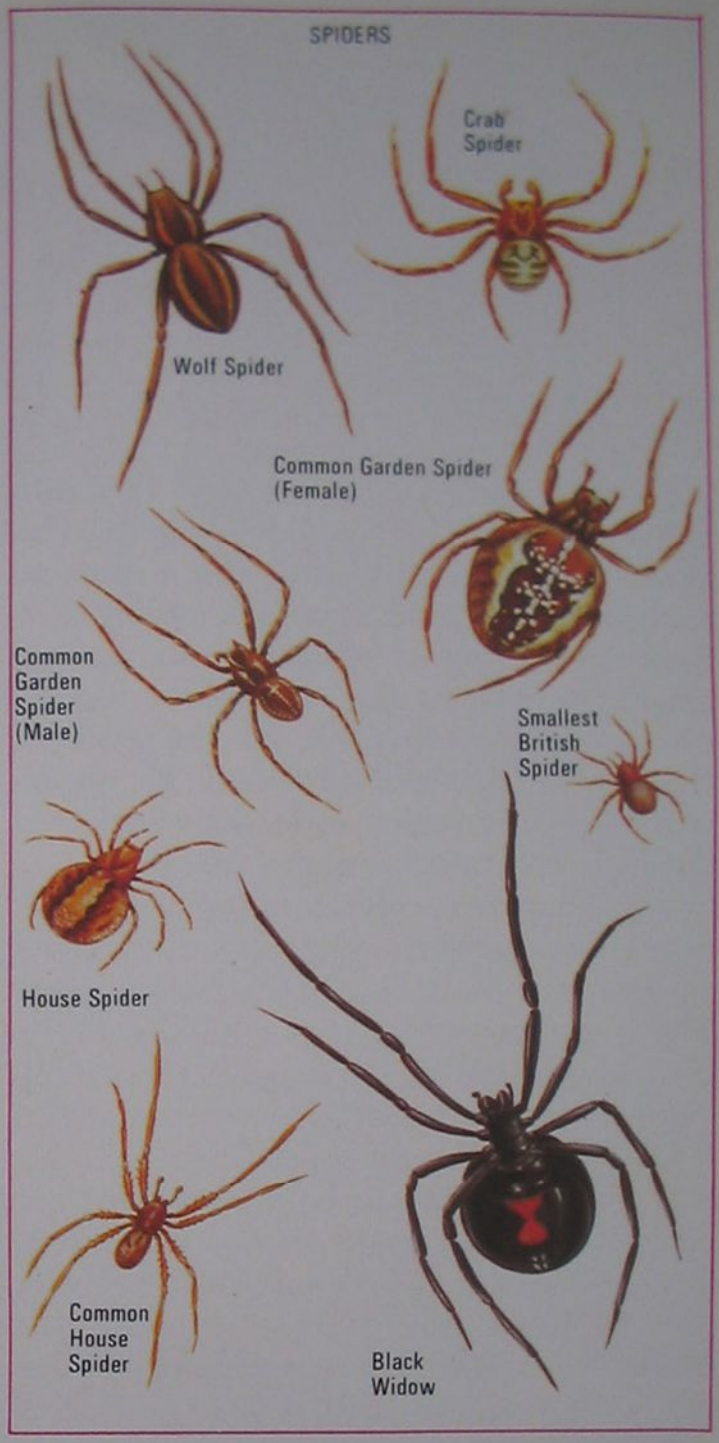
A Greek sphinx stopped all passers-by to ask them: 'What walks on four feet in the morning, on two at noon, and on three in the evening?' Oedipus solved the riddle by answering: 'Man crawls on all fours as a baby, walks upright in the prime of life, and uses a staff in old age.'

God, and therefore identified with the Pharaohs. The Giant Sphinx takes the form of a lion with the head of a king (probably King Chepren for whom it was carved), though other forms of this fabulous beast have the bodies of lions and the heads and wings of hawks.

Spices are flavourings made from plants. Common strong spices include pepper, mustard, nutmeg, cinnamon, ginger and cloves. Herbs such as sage, thyme, rosemary and marjoram produce spices of a delicate flavour.

Spices are made from the dried parts of plants, and are usually ground to powder. They are used, either singly or in combination, to give special flavours to foods. Curries are made by using various mixtures of spices when cooking meat, vegetables, or rice.

Many spice plants grow only in tropical regions such as the Moluccas or Spice Islands in Indonesia, a long-famous source of spices. Spices were sought after by people in the Middle Ages, and the spice trade was very important. Before food preservation methods were discovered, spices helped to improve the taste of much of the food that people ate.



Spiders are small animals with bodies made up of two rounded sections. Four pairs of jointed legs are attached to the front section. Together with scorpions and mites, spiders belong to the group of animals called *arachnids*—a division of the arthropods.

There are about 20,000 different kinds of spiders. They vary in size from a fraction of an inch across to as much as eight inches, including the legs. Spiders live pretty well everywhere, from the tops of trees to the soil. They all feed on other animals, mainly insects, and live wherever they can find food. This means that they often live in houses.

All spiders can produce fine gossamer threads from their spinnerets, which are at the back end of the body. Many spiders spin the threads into beautiful, delicate webs. They first let out a fine, sticky thread that floats freely until it attaches itself to a twig or some other object. The spider then builds a framework rather like a spoked wheel of non-sticky threads. Then it completes the web by laying a spiral of sticky silk over the spokes. The spider remains attached to a thread at the

A bird-eating spider

side of the web. When an insect flies into the web, it gets stuck and struggles. The spider feels the struggles and rushes to its prey, wraps it in more silk and bites it, injecting it with poison from special glands in its mouth. The spider has oil on its legs and so does not get stuck on the web. The spider injects its victim with digesting juices and slowly sucks out the digested interior of the insect.

Not all spiders catch their prey in webs. Some, such as bird-eating spiders and wolf spiders, are hunters and stalk their prey. The trap-door spider digs a burrow in the ground and builds a hinged lid to it. The spider remains inside the burrow, which it lines with silk, and when an unwary insect walks overhead, the spider pops out of its hiding place and attacks the insect. The crab spider lies in wait inside a flower and captures insects that come to the flower for nectar. The water spider makes its home in an underwater nest made of silk, breathing by trapping bubbles of air on its body. It preys on small water insects.

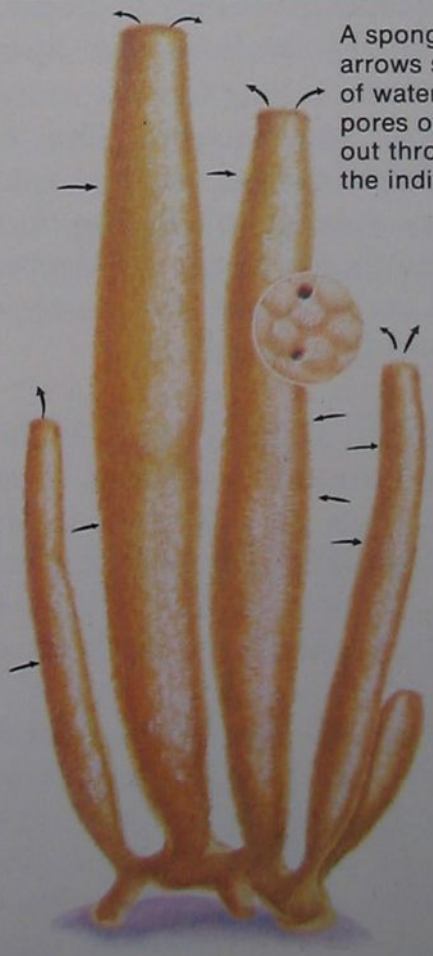
Spiders are born from eggs laid inside a silken cocoon. Some spiders release their young from the cocoon, but other kinds have to make their own way out. Some young spiders move about by sending a streamer of silk into the air, and letting the wind catch it and blow them away.

Although spiders have a poisonous bite, few are harmful to man. The black widow spider is the most dangerous, but its bite is very seldom fatal.

The Turkish woman on the right is using a hand spindle, one of the oldest methods of spinning. As the twirling stick falls, it draws out and twists the thread from the combed wool she holds under her arm.

Spinning and weaving are basic operations in the making of textiles. Spinning means turning the raw fibre into a continuous yarn by drawing it out and twisting it. Weaving means turning the yarn into cloth by passing sets of threads alternately over and under one another at right angles. From ancient times until the Industrial Revolution, both arts were practised at home by hand. Today, factory machines produce cloth automatically.

Sponge This is a very simple animal. The sponge you may wash with is in fact the skeleton of the animal. A sponge is made up of a colony of tiny animals containing pores or holes through which water is drawn in. The animals then digest any food particles in the water. Sponges are grouped together in the *phylum* (major group) called *Porifera,* meaning *pore bearers.* Sponges



A sponge colony. The arrows show the passage of water in through the pores of the body wall and out through the 'neck' of the individual.

Sonia Halliday

attach themselves to rocks on the sea bottom, and may be brightly coloured. They live in all the oceans, but are most common in warmer seas. Some sponges live in fresh water.

Each sponge colony is supported by a skeleton of silica, chalk, or *spongin*, a horny substance. It has a complicated network of channels, and sponges often grow into shapes resembling bushes or vases, as well as globes. When the colony dies, the skeleton is left behind as the flesh decays. Some of these skeletons are soft and flexible, and these are the kind used for cleaning. The best commercial sponges come from the Adriatic Sea. Sometimes the skeletons left behind are delicate and lace-like, as in the beautiful Venus' flower basket.

Squirrel This is a small furry *rodent* (gnawing mammal; see Rodent). There are over 300 kinds of squirrels, living in almost all parts of the world. The well-known tree-squirrels are slender, graceful animals, generally about 18 inches long, including the long, bushy tail. The Malabar squirrel of India, however, reaches a length of three feet. Red and grey squirrels are common tree-squirrels in many parts of the world. They are fond of nuts, and often keep a store of them in a hollow tree to eat in winter. But they also eat insects, eggs and small birds. Unlike grey squirrels, red squirrels have bushy ear-tufts.

Many kinds of squirrels do not live in trees at all. These ground-squirrels and marmots are generally more heavily built and slower than their tree-dwelling cousins. Some of them live on nuts and seeds, but others eat grass. They live in burrows dug in the ground, and include the prairie-dog and gophers of

Left: The grey squirrel is a common tree-squirrel in America. It was introduced into Britain in the 1800's and has become common there.
Right: The red squirrel is the native squirrel of Europe and Asia. But in Britain, it has been ousted from many places by the grey squirrel. The two can be told apart by their ears as well as their colour. The red squirrel has tufted ears.

North America and the susliks of Asia. Chipmunks are also kinds of ground squirrels.

Staffordshire, a county in the West Midlands of England, includes the pottery centre of the United Kingdom. Its county town is Stafford, and its population is 1,857,000.

Most of Staffordshire is a gentle, rolling plain, consisting of the vale of the River Trent and its tributaries. The Pennine Hills are in the north, rising to 1,756 feet at Axe Edge. In the centre of the county, 50 square miles of wild moorland called Cannock Chase gives welcome relief from the highly industrialized landscape that surrounds it. The *Black Country,* in the south, gets its name from the South Staffordshire Coalfield.

The *Potteries* at Stoke-on-Trent—a union of the five towns of Burslem, Fenton, Hanley, Longton and Tunstall—were founded on the North Staffordshire Coalfield. Burton-on-Trent, on the county's eastern border is one of Britain's main brewing centres.

In the Black Country, Wolverhampton is the largest town, and from there across the border to Birmingham, there is an almost unbroken chain of industrial centres, formed by such towns as Walsall, Dudley, Smethwick and West Bromwich.

Stagecoaches were an important means of transport in the 1700's and 1800's. A stagecoach was a horse-drawn coach. It carried passengers over a specified route, and ran regular services, just as long-distance buses do today. It also carried mail and, sometimes, goods. At stops or 'stages' along the route, the tired horses were replaced by fresh ones. That is how the name *stage coach* originated.

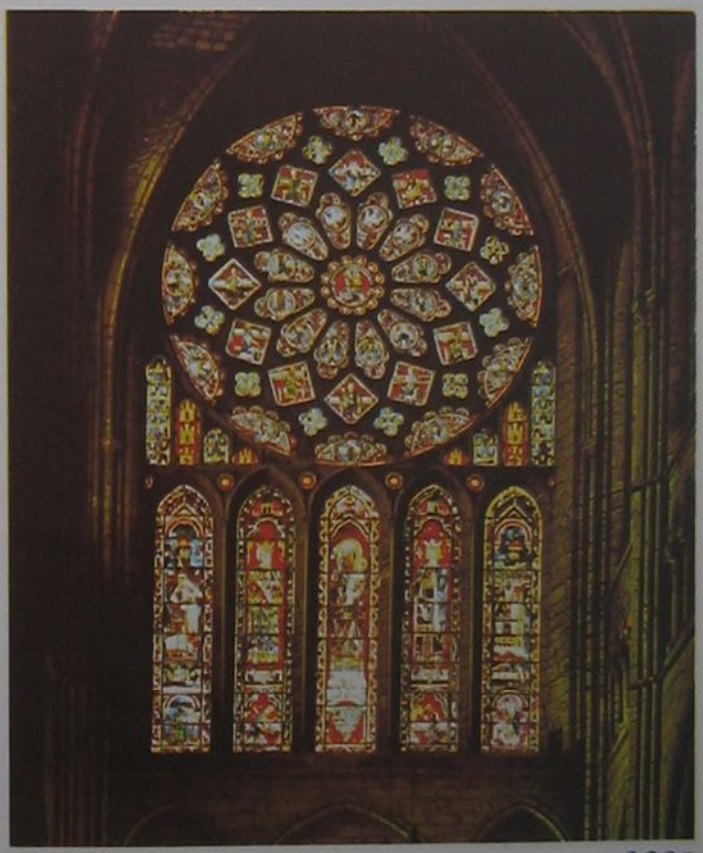
A typical stagecoach could carry from eight to fourteen passengers. Some sat inside, and some sat on top. It also had room for luggage and boxes on top. The driver in front managed a team of four or six horses. A stagecoach journey usually took a long time. In summer a coach could cover 40 miles a day. In winter the going was much slower. Stagecoaches often met with accidents and breakdowns on the road. There was always the danger of highwaymen.

The first regular stagecoach service began in 1670. It ran between London and Edinburgh.

Stained glass is used to make beautiful windows for churches and other buildings. The most famous stained-glass windows, dating from the 11th century, are found in the cathedrals of France, Germany and England. They depict scenes from the Bible, saints, and apostles, with surrounding geometric designs. Twentieth-century artists, such as Marc Chagall, have used the old methods to create modern effects.

The artist's plan for a window is called a *cartoon.* On the basis of it, the glass is cut into the various shapes required. The glass may be coloured in the molten

Chartres Cathedral in France has some of the finest examples of 13th-century stained glass. During the Second World War the glass was removed and stored away for safety.



state with various metal oxides, or the colour itself or details may be enamelled on to the surface of the glass and then fired. Lead strips, soldered to one another, hold the pieces together, at the same time giving strong outlines.

Stalactites and stalagmites Limestone, a rock consisting largely of calcium carbonate, is dissolved by rainwater. Areas of limestone are famous for their caves.

Water seeping through limestone dissolves much calcium carbonate. Drops of water on the ceiling of a cave evaporate, leaving small mineral deposits on the ceiling. These deposits grow slowly down to form a long icicle-like column called a *stalactite*. Water dripping from the ceiling may also deposit calcium carbonate on the floor of the cave. These deposits grow upwards into columns called *stalagmites*.

Stalin, Joseph (1879-1953), was head of the Russian government from 1929 until his death. He made himself a dictator by controlling the leading posts in the Communist Party and in the state. He crushed his enemies cruelly, and allowed nothing and nobody to stand in the way of his policies. In 1935, he began a series of *purges* in which many thousands of politicians and army officers whom he suspected of opposing him, were executed.

Stalin was born Joseph Dzugashvili, the son of a poor Georgian cobbler. He studied for the priesthood, but at 19 he became interested in communism. He worked under Lenin, leader of the Bolsheviks, who were later called the Communist Party. This party came to power after the Revolution in 1917. In 1922 Stalin helped to bring the various Russian countries together, as the Union of Soviet Socialist Republics (U.S.S.R.). He was a very skilful organizer and became secretary-general of the party.

Stalin helped to develop industry and agriculture by a series of *five year plans*. All privately-owned businesses were taken over by the government. Private farming was abolished and the peasants were forced to work on *collective* farms run by the government. Industry was geared to the production of heavy machinery; household goods and luxuries were hardly made at all. He united the people to make Russia a strong country in the event of attack from outside. He feared the growing power of Germany, but signed a pact with Hitler in 1939. When the Germans invaded Russia in 1941, Stalin joined forces with Britain and her allies to crush Germany. After the war, Stalin spread communism to much of eastern Europe, which had been occupied by Russian troops.

Stalin was a hero of the Russian people, but three years after his death, he was denounced by the new leaders as a power-mad dictator.

Stamps and stamp collecting Postage stamps are stuck on to a letter or any other postal packet to show that the post office has been paid its fee for carrying the

Left: A beautifully formed stalagmite called the Minaret in River Cave at Jendan in Australia.

Right: Joseph Stalin.

packet to its destination. People buy the stamps at post offices. When the item starts on its journey, the stamp is *cancelled* (marked through with lines) so that it cannot be used again. The *postmark* on the letter shows where and when it was posted.

Britain issued the world's first postage stamps. They were the famous Penny Black and Twopenny Blue stamps of 1840. Three years later Brazil and the Swiss canton of Zurich put out stamps. Before long all other countries began issuing their own.

Collecting stamps is probably the world's most popular hobby. It is enjoyed by young and old alike. Many famous people, including King George V of Britain, have been keen collectors. Stamps are interesting for several reasons. One is their variety and beauty. They have been printed in all sorts of colours. They picture millions of different subjects—plants and animals, famous events, kings and queens, and great works of art.

Through an interest in stamps, a collector can learn much about geography or history. And occasionally a valuable stamp may come into his hands. To be valuable a stamp must be rare or be unusual in some way. Examples of unusual stamps are those with faulty perforations, and those whose designs have been printed wrongly. Stamp catalogues list all the stamps that have been issued, and give their value.

Collectors usually keep their stamps in an album arranged country by country. They prepare the stamps by first soaking them in water to float them off their envelopes. Then they stick them into the album using gummed hinges.

Collectors study carefully the condition of each stamp they obtain. For example, they note whether it is mint (new) or cancelled (used), and they examine the condition of the paper and perforations. Many people collect *first-day covers*. These are stamps postmarked on the day of issue.

To be valuable a stamp must be rare or unusual in some way. The Cyprus stamp is the highest denomination of any stamp. In 1930 Germany issued a set of airmail stamps (Deutsche Luftpost) commemorating the flight of the Zeppelin from Europe to South America.

Standard of living There are rich and poor countries. A rich person is a person who owns a great deal of wealth in capital or land. A rich country is one which has a large national income produced by its capital, that is its machinery and natural resources, and by the skill of its people. The people of a rich country have, on average, a high standard of living and can buy good houses and food to keep themselves healthy.

The difference between the standard of living of rich and poor people and rich and poor countries is the main cause of conflicts in the world today. When governments cannot provide rapidly rising standards of living for the poor, there is pressure for revolution. Revolutionary movements appeal to the poorer workers and to the peoples of poor countries and to all those who feel that this inequality is unfair.

Many rich countries give aid in cash and kind and by lending skilled people to the underdeveloped, poorer countries. In the same way, through the social services, they try to help their own poorer citizens. There are world wide charitable movements, collecting money and trying to arouse public opinion to the problem—Oxfam and the Freedom from Hunger Campaign.

Stanley, Sir Henry Morton (1841-1904), was a famous explorer of Africa. He was born in Wales. At the age of 18 he worked his way to America on board a ship. There he fought in the American Civil War on the Confederate side before becoming a successful newspaper writer. In 1871 the *New York Herald* sent him to Africa to search for the Scottish explorer David Livingstone, who had been missing for years. Stanley found the ailing Livingstone at Ujiji near Lake Tanganyika. He could not persuade Livingstone to leave Africa. Livingstone died soon afterwards.

In 1874 Stanley returned to Africa to continue Livingstone's work. He visited Lake Victoria, and travelled 1,600 miles down the Congo River. Stanley later reached the Ruwenzori Mountains and helped Belgium take control of the Congo.

Starfish *see* Echinoderms.

Stars Year after year the stars seem to remain unchanged in the sky. The constellations looked much the same to the Ancient Greeks as they do now.

Even so, stars do not last for ever. In the year 1054 a brilliant star suddenly appeared in the sky. For two years it shone so brightly that it was visible during the day. Then it faded away. All that remains now is a mass of faintly glowing gas—the Crab Nebula.

This was one of the first recorded *supernovae*, stars that end their lives in a tremendous explosion. By no means every star ends its life as a spectacular supernova, but every star has a definite beginning and a definite end.

Some stars are so large that if the Sun were at their centre the Earth would also be inside the star. Other stars are much smaller than the Sun. The brightest stars are a thousand million times brighter than the dullest ones.

As we look at them in the sky the stars vary in brightness, a few being very bright indeed while others are so faint that they can hardly be seen. The brightness of a star is called its *magnitude*. It is not a reliable guide to the star's real brightness, because the farther away a star is the fainter it looks. Thus a very bright star which is very distant may look much fainter than a not very bright star which is comparatively close to us.

Some stars are called *variable stars*. The light we receive from these is changing in brightness all the time. By carefully recording the changes, astronomers have discovered that some variable stars grow bigger as they become bright, and smaller as they fade.

Some stars form what are called *binary systems*. These are two stars close together, circling around a point situated between them. The light from some binary systems varies in a very special way, because from time to time one of the revolving stars passes in front of the other, cutting off its light from us. These are called *eclipsing binaries*.

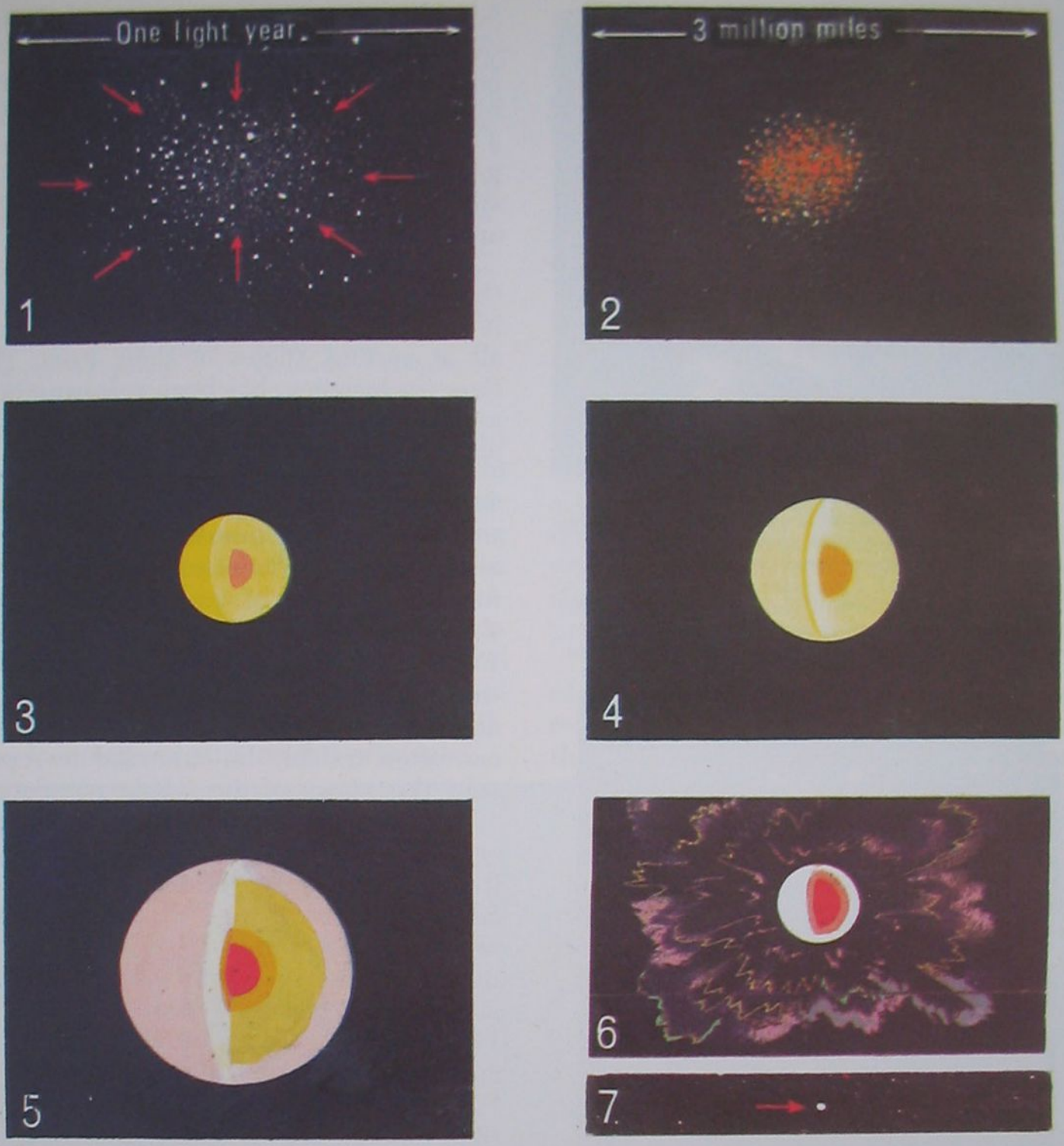
Observations of variable stars have helped astronomers to understand the Universe in several ways. By studying the light variation of binary systems they can calculate how heavy the stars are.

In 1968, astronomers found stars that produce regular pulses of radio waves and light up to 30 times a second. These *pulsars* may be produced in supernovae.

Some people believe that stars are formed from vast clouds of dust and hydrogen gas in space. Gravitational attraction between the atoms of gas gradually draws them together, and the huge cloud, called the *protostar*, begins to get smaller.

As the protostar shrinks, the temperature at its centre rises. When it reaches 1,800,000°C. the star settles down to a steady and much slower process of 'middle age'.

During the middle age of a star, atoms of the gas hydrogen are continually combining to form atoms of a heavier gas—helium. Each time an atom of helium is formed from hydrogen atoms, energy is released in the form of light and heat.



Many millions of tons of hydrogen must be converted into helium each *second* to make the vast amount of energy produced by a star.

Most of a star's energy is given off into space, but a little is retained, causing the star to grow hotter. When the temperature at the centre reaches 100 million degrees C. the star expands, and helium atoms start to join together to form heavier atoms.

If this process takes place too quickly,

The Life of a Star

1. A *protostar*, a huge cloud of rarified hydrogen gas, condenses to form a star. Gravitational forces pull the atoms together. 2. The contraction stops when the star gets so hot that expansion counteracts the contraction process. 3. The temperature of the star's core is now about a million degrees Centigrade. Thermo-nuclear reactions start, converting hydrogen into helium. 4. The helium core expands, and the star gets hotter and expands. The Sun is midway between stages 3 and 4. 5. Helium atoms fuse to form heavier elements. The temperature rises rapidly, and the star expands into a *red giant*. 6. The star alternatively may expand very quickly, becoming a *nova*. It explodes, shooting matter into space. 7. All the fuel is eventually used up, and the star contracts into a *white dwarf*.

Above: Stars are formed from vast clouds of dust and hydrogen gas in space, such as the cloud obscuring part of the Orion nebula. Below: A nova signals the end of a star. In 1901, a star went nova in Perseus. These pictures taken in 1917 (below) and 1933 (centre) show luminous gas moving away. Bottom: The Crab nebula is the remains of a star that went nova in 1054.

the star explodes, shooting matter into space. Such an occurrence, the supernova stage, is rare. More often, the star expands slowly into a huge red star, called a *red giant*. Finally, when all the hydrogen 'fuel' has been used up, the star shrinks again to become a *white dwarf*, and 'dies' as it cools and grows fainter.

The birth and death of a star takes thousands of millions of years. The process is studied by observing thousands of stars, all at various stages of their lives. The Sun, for instance, has been releasing heat and light for about 5,000 million years and is halfway through its middle age.

Statistics are facts, generally expressed in the form of numbers, obtained by analysing a lot of information or data. For instance, a team of questioners may ask a hundred people their views on politics. From the masses of answers, a statistician can work out how people would vote in an election. The statistics from such a poll can often reliably be extended to represent the views of the whole population.

To do this, the statistician must observe certain conditions: the sample of people from whom he obtains his answers must be fairly large. Otherwise the statistics will not be representative. He must phrase the questions in such a way that the person answering is not influenced in his reply. For example: 'Don't you think that the splendid government that we have now is better than the corrupt and inefficient opposition?' is a *loaded* question. The statistician obviously wants to hear the answer 'Yes'.

The people questioned must represent a typical cross-section of the population, and include rich people as well as poor people, young people as well as old people, and so on. If the questioners were to interview only people belonging to one particular political party, they would get very different statistics. Nor could these statistics be taken to represent the views of the country as a whole.

Unscrupulous people can deliberately

come up with misleading statistics for purposes of gain or propaganda. Perhaps that is why the American author Mark Twain once said: 'There are three kinds of lies: lies, darned lies, and statistics.'

Talking points

* Discuss the main requirements that are needed to produce an accurate statistical survey. Do you think that statisticians always observe these requirements?
* In what way can statistics be used to improve the efficiency of shops, offices, factories and hospitals?
* Before an election, contesting parties often commission separate statistical surveys of voters. These surveys often have different results, each showing that the party which has commissioned the survey will win the election. Why does this difference occur?

Articles to read

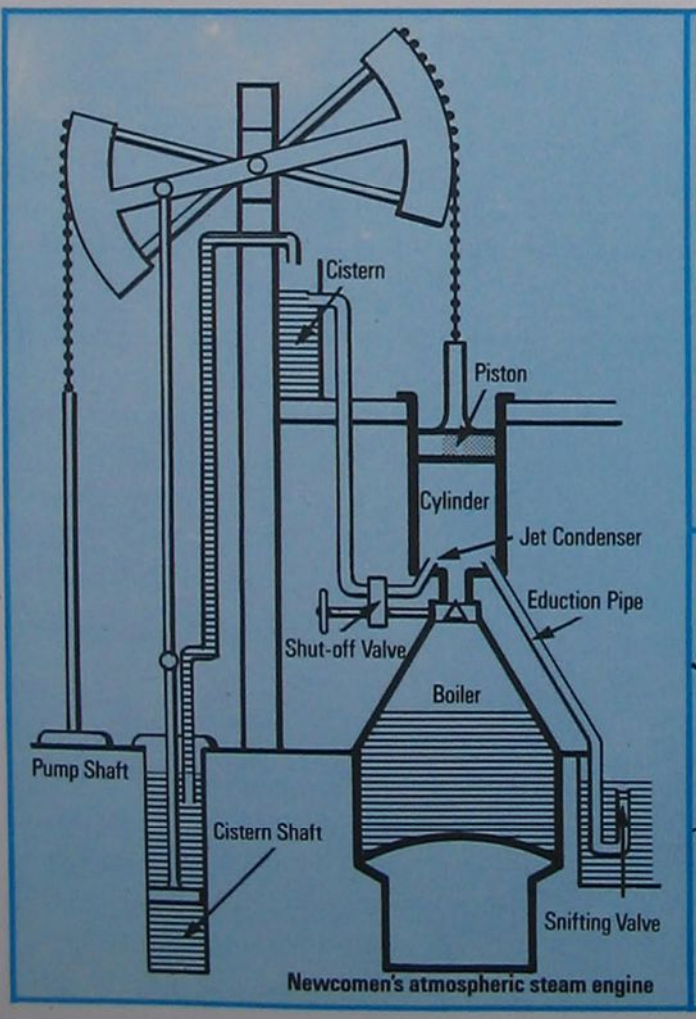
Computers; Mathematics; Probability; Propaganda.

Steam engines are far more important today than it might be thought, but not in their original form. Originally, the steam engine used the energy of expanding steam to push a piston up and down in a cylinder. The *reciprocating* (up-and-down) movement of the piston was changed into a *rotary* (turning) motion which could drive the shafts or wheels of machinery. The few remaining steam railway locomotives work on this principle.

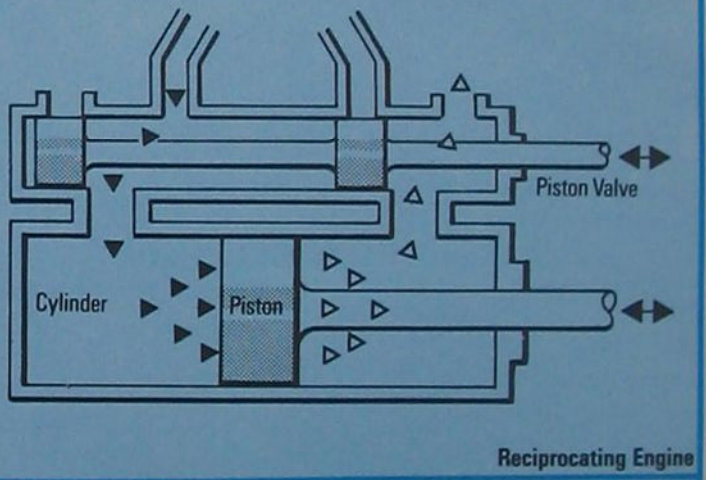
The modern steam engine is the *steam turbine*, in which the expanding steam spins the blades of a turbine. It produces rotary motion directly. The turbine in turn drives other machinery. Two-thirds of the world's electricity is produced by turbine-driven generators. Practically all ships are powered by steam turbines.

However, in the earliest steam engines power was produced not by expansion of the steam but by *condensation*—turning it back into water. Condensation of the steam in a closed vessel creates a vacuum, which produces a 'sucking' action. Thomas Newcomen's beam engine of 1712, had a cylinder with a piston in it. The cylinder was filled with steam and then water was sprayed into it to condense it. The sucking action produced caused the piston to move down.

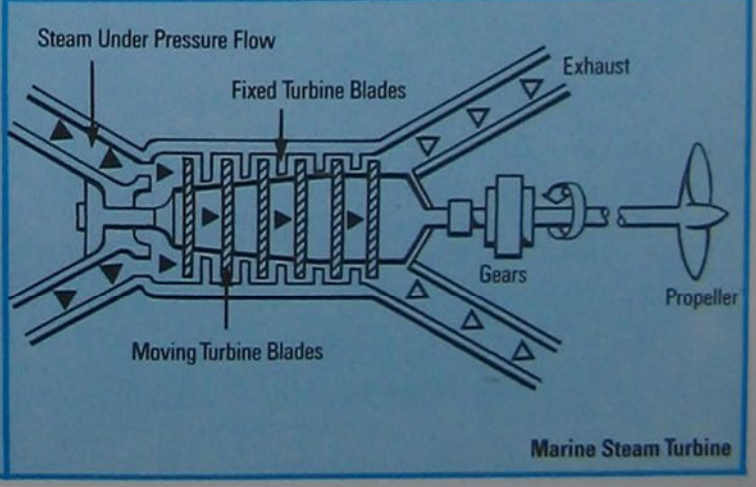
James Watt (1769) improved this type of engine by making the steam condense in a separate condenser. This meant that the steam cylinder could always re-



Newcomen's atmospheric steam engine



Reciprocating Engine



Marine Steam Turbine

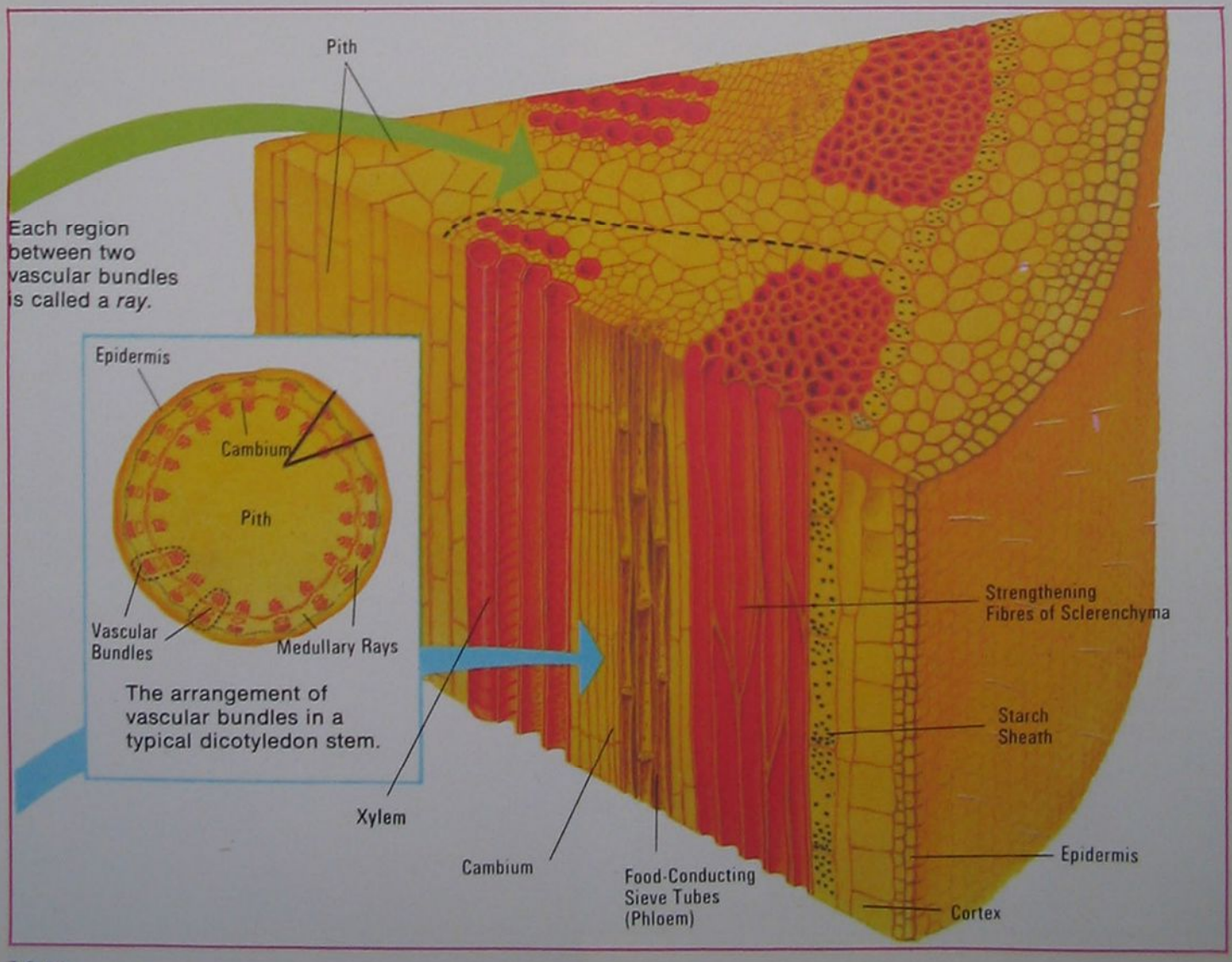
main hot, instead of being alternately heated and cooled. The saving in fuel was enormous. Later Watt improved his engine further by introducing steam alternately above and below the piston. This *double-acting* engine produced power on each stroke of the piston.

Later steam engines had more than one cylinder and worked at much higher pressure than Watt's engine. They were called *compound* engines. They were widely used in the 1800's in industry, ships and locomotives. In 1884, Charles Parsons invented the steam turbine.

Stems bear leaves and flowers and normally hold a plant upright. Most stems are round in cross-section, although occasionally they may be flattish and oval, square, or even triangular.

A thin slice taken across a stem and viewed under a microscope shows numerous patches whose most conspicuous contents are groups of thick-walled cells. These are called *vascular bundles*. The thick-walled cells are *xylem vessels*, which conduct water. Vascular bundles also contain some thinner-walled *phloem cells* which conduct foods in solution. In plants called *dicotyledons*, which have two seed leaves and net-veined leaves, the vascular bundles occur in a more or less precise ring in the stem. In *monocotyledons*—those with one seed leaf and parallel-veined leaves—they are scattered at random.

Stems grow from their tips. There, a rapidly dividing group of cells elongates quickly, lengthening the stem just behind the tip. The lengthening cells also acquire different characteristics, depending upon where they are situated. The ones around the outside develop in protective *epidermal* cells. Some strands



of cells are able to carry on dividing for a while, and these become the vascular bundles. In dicotyledons that persist from year to year, a ring of cells called the *cambium* links the vascular bundles together. The cambium produces new xylem cells towards the inside of the stem and phloem towards the outside.

The stems of some plants are modified to fulfil other functions. Potatoes bear some stems that never appear above ground. Their tips swell and become packed with starch to form potato tubers.

Though stems are green and can make some food of their own, most plants leave the job to the leaves. In cacti, however, the leaves are lost as an adaptation to desert life and the stem makes the food as well as bearing the flowers.

Stephenson, George (1781-1848), was an English engineer who invented the first successful steam locomotive. Other inventors had previously designed steam locomotives, but Stephenson's version was a great improvement.

His father was an engine-keeper at a colliery, and as a boy Stephenson would make model engines to play with. He began his working life in a colliery as a fireman. In the evenings Stephenson went to night school to try to get a basic education. Later on he became an engine-wright at a colliery, and it was there in 1814 that he built his first locomotive. This was used for transporting coal and had a speed of six miles an hour.

Stephenson's inventiveness was not just confined to engines. In 1815 he designed a miner's safety lamp, for which he was awarded £1,000.

In 1821 Stephenson became responsible for the construction of the Stockton and Darlington Railway, which was completed in 1825. He was also the engineer concerned with the building of the Liverpool and Manchester Railway, which took from 1826 to 1830 to complete.

At this period, Stephenson was still improving his locomotive designs, and in

Above: A painting of the opening of the Stockton and Darlington Railway in 1825. This railway, the first public railway, was built by George Stephenson. Below: Steam locomotives are a rare sight nowadays.

1825 he built the first steam locomotive to run on a public railway, the Stockton and Darlington. This was capable of pulling both passenger and cargo wagons, and reached a speed of up to 12 mph.

In 1829 his most famous locomotive, *The Rocket*, made its first run and achieved a speed of 30 mph, a great performance for that time. Stephenson worked as chief engineer on many of the new railways, and enthusiasm for them became widespread.

Stephenson's inventions brought him much financial success, and he devoted a great deal of his time and money to improving the conditions of miners and their families.

Stereophony is recording sound from two different places in a room, then playing it back on separate speakers, in order to give the recording a feeling of depth and

realism. It differs from *monophony* in which only a single recording is made.

In producing a stereophonic recording of an orchestra, two microphones in different parts of the concert hall, pick up the sound simultaneously. Each of these inputs is then recorded on to the separate walls of a single record groove, or in the case of magnetic tape, on different tracks. A stereo *stylus* (needle) on the turntable picks the electrical impulses up separately from each wall of the groove. The impulses are greatly *amplified* (made more powerful) each by a separate *amplifier*, and fed to separate speakers placed some distance apart.

Stevenson, Robert Louis (1850-1894), a Scotsman, was the writer of some of the best-loved adventure books in the English language. They include *Treasure Island* (1883), a story of pirates and buried treasure; *Kidnapped* (1886), about a murder in the Scottish highlands; and *The Strange Case of Dr Jekyll and Mr Hyde* (1886), a horror story about a man with a double personality. Stevenson wrote a delightful collection of poems, called *A Child's Garden of Verses* (1885).

Stevenson was born in Edinburgh. He studied engineering and tried law before deciding to become a writer. Stevenson suffered from the serious disease of tuberculosis from his youth. Because of his poor health he travelled a great deal. He used his travels as the basis of his books.

Stevenson first journeyed to the mainland of Europe. Later he went to America, where he married. In 1890 he took his family to the beautiful islands of Samoa, in the South Seas. There he settled and became honoured by the natives.

Stick insect The stick insect is a long, thin, green or brown insect that resembles a twig. Many stick insects have no wings, and are very hard to spot among the twigs in which they live. In this way, they escape the attention of their enemies.

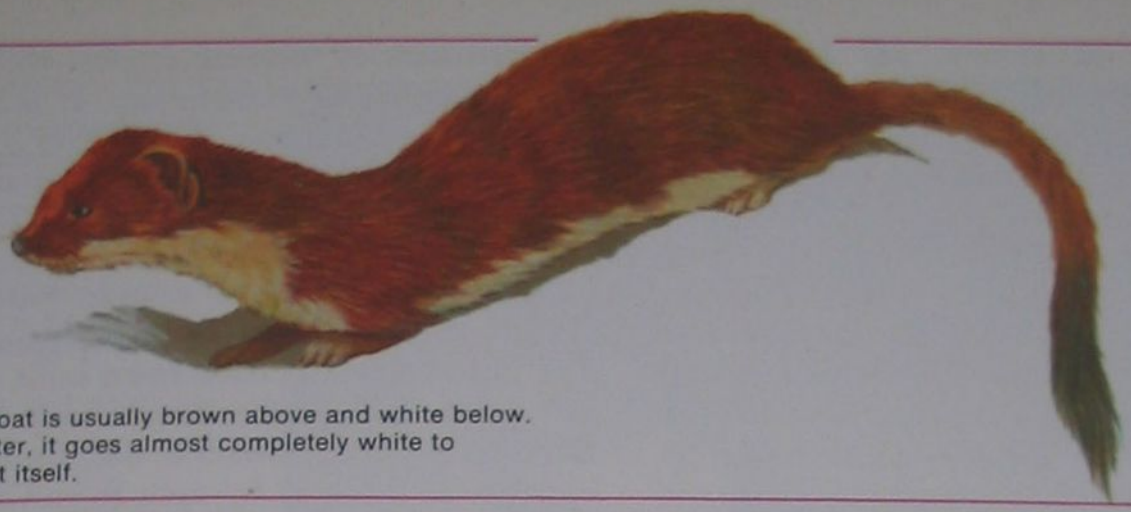
Stick insects are related to grasshoppers. There are a few hundred different kinds of stick insects, most of them living in warm countries. The commonest stick insect is about three inches long. But one species reaches a length of nearly one foot and is the longest of all insects.

Stick insects eat leaves, and are easy to keep at home. They will feed on privet leaves, as well as ivy, blackberry, and other common plants depending on the species. The female usually drops her seed-like eggs on the ground, and few of them survive to hatch. Males are very rare in some species, and the females lay eggs without mating.

Right: A stinging nettle. Left: A deadnettle, often confused with the stinging nettle but without stinging hairs.

Stinging nettle This is a common weed whose leaves and stems cause painful stings. The sting in a nettle is carried in tiny hairs that stick out from the stem and from the undersurfaces of the leaves. Each hair consists of a long, needle-shaped cell with a ball-shaped tip. When you touch one of these hairs, the spherical tip breaks off and the sharp tip of the needle pricks your skin. The wall of the 'needle' has stiffening materials in it to prevent it buckling, and the needle itself contains poisons that cause swellings and irritation.

Stinging nettles have drab green flowers and are pollinated by wind. The flowers hang in loose bunches and the pollen is tossed out by the breeze. Male and female flowers arise on different plants.



The stoat is usually brown above and white below. In winter, it goes almost completely white to protect itself.

Stirlingshire (area 450 square miles) is a county of central Scotland that lies between the Firth of Forth in the east and Loch Lomond in the west. Its county town is Stirling, and its population is 209,000.

In the north-west, the county touches a fringe of the Highlands, where Ben Lomond rises to 3,192 feet. A lower range of hills, the Campsie Fells, runs across the centre of Stirlingshire. The principal rivers are the Forth, Endrick and Carron. Sheep are reared in the hills, and oats and potatoes are grown in the lowlands.

Stoat The stoat is a small flesh-eating mammal that is in the weasel family. It lives in much of Asia, Europe and North America. It has a slim body, short legs and a thin black-tipped tail. It reaches about 15 inches in length and feeds on small birds and mammals.

The stoat normally has brown fur on its back and whitish fur on its underparts. In cold regions, the animal grows white fur for the winter, but it keeps the black tip on its tail. This soft winter-fur is valuable and is known as *ermine*, with its distinctive black spots formed by the tail-tips.

Stockholm is the capital city of Sweden. It is situated partly on the mainland and extends to several islands where Lake Mälaren empties into the Baltic Sea. The city (pop. 1,307,000) has commercial and manufacturing interests and is the chief cultural centre, with many academic institutions. The old town dates from the thirteenth century with quaint houses and narrow alleys, contrasting strongly with modern open-style Swedish architecture. The Royal Palace, built in the eighteenth century, contains many treasures. The Storkyrkan (Cathedral of St Nicholas) in the old town dates from 1260.

Stocks and shares A company must have money to start and carry on its business. Often, it obtains this money by selling shares in the ownership of the company. The people who buy the shares are called *shareholders*. They become part-owners of the company, and are said to be *members* of it. The money that a company obtains by selling shares is called its *share capital*.

Each share in a company is valued at a

The city hall at Stockholm, inaugurated in 1923, stands off the shore of Lake Mälaren.

certain sum of money, say £1 or ten pence. A shareholder may buy as many shares as he likes and as the company offers for sale. He may buy 1,000 shares, say, or 100, or only 5.

Each year, the directors of the company declare a *dividend*, a sum of money to be divided up among the shareholders as profit on the money they have invested in the company by buying shares. The directors decide on the dividend to be paid by studying the company's income during the year, allowing for the company's working expenses, and setting aside money to be used for further development of the company.

There are two kinds of shares, *ordinary shares* and *preference shares*. Holders of preference shares have a preference over the ordinary shareholders in the payment of dividends. No dividend on ordinary shares can be paid until the fixed dividend on preference shares has been paid in full. If the company makes a large profit, the ordinary shareholders may receive an increased dividend, but the preference shareholders get no more than the fixed rate.

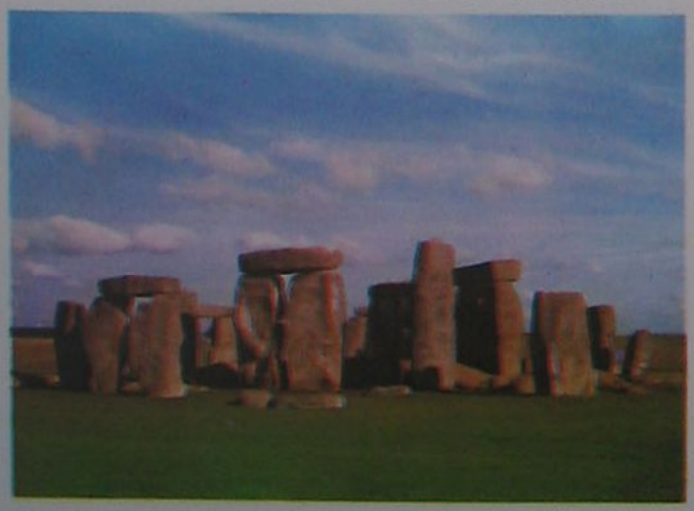
Sometimes companies turn shares into *stock*. Stock is a 'parcel' of shares. You cannot buy part of a share, but you can buy or sell part of a stock.

Stonehenge On the Wiltshire downs, eight miles north of Salisbury in England, are the remains of several circles of huge stones, known as Stonehenge. It is fairly certain that this was the site of a sun temple, erected and enlarged over a long period, sometime between 1800 and 1400 B.C.

Once regarded as a temple built by Druids (priests of early Celtic peoples), it is now known to have been built some 200 years before the Druid cult flourished. It is even possible that its building was supervised by men from Greece or Crete, since it resembles sun temples there, and carvings on the stones depict axes and daggers similar to those used at Mycenae, in Greece.

Part of the original temple was probably made of wooden posts, later replaced by circles of huge stones, which must have been brought from Pembrokeshire, in Wales. There are five great *trilithons* (two uprights with a third stone surmounting them) in the inner circle, with smaller stones forming another circle, in the centre of which is the Altar Stone. Each midsummer morning, the Sun can be seen rising above the tip of one stone known as the Sun Stone.

Stonehenge. The lintels on top of the stones are kept in place by tenons, one of which can be seen.



Stravinsky, Igor Fedorovich (1882-1971), was a Russian-born composer who wrote ballets, choral and orchestral works, and one opera. Stravinsky was born in St Petersburg (modern Leningrad). He met the composer Rimsky-Korsakov and became his pupil in 1902. Stravinsky's first ballet, *The Firebird* (1910), written for Diaghilev's company, was an immediate success. But another ballet, *The Rite of Spring* (1913), caused a riot at its first performance because the audience found the piece too modern and disturbing. During his middle years, Stravinsky composed in the classical style of the 18th century. Stravinsky made his home in France from 1920 to 1939, and from then on lived in the United States.

Stringed instruments produce sound by means of stretched 'strings' (often of

The guitar is perhaps the most popular of all stringed instruments. It is also one of the oldest. Its ancestry has been traced back as far as 1000 B.C. when instruments similar to the guitar were being played in the Middle East.

catgut, nylon, or metal wire) which are made to vibrate. But the strings alone do not produce the whole sound. There is almost always a soundbox of some kind (usually wooden), which is also part of the instrument. It picks up the vibrations from the strings and *resonates* with them, so *amplifying*, or magnifying, the sound.

In one type of stringed instrument the player plucks the strings with his fingers or with a *plectrum* or pick. The *harp*, *guitar*, *banjo* and *mandolin* are a few examples of this type. In another group of stringed instruments, the player produces the sound by rubbing the strings with a special *bow* made of horsehair. The instruments of the *violin family*, including the *violin* itself, the *viola*, the *cello* and the *double bass*, are the best known of these. Still another group of stringed instruments is played by striking very taut strings with a hammer. The *piano* and *clavichord* are played in this way though these are often classified as keyboard instruments.

In all stringed instruments, the length of the string determines the *pitch* (highness or lowness of the tone). Some instruments, such as the piano, and harp, have a different string for every note, but most of the others have a few strings only with which to produce all the notes. In this type of instrument the player regulates the length of the vibrating part of the string by *stopping* (holding his finger down on) the string at the appropriate place.

Stuart, John McDouall (1815-1866) was a Scotsman, who helped to blaze a trail through Australia's remote interior. After making several early expeditions as far as the centre of the continent, he set out, in 1861, to cross it completely from south to north, beginning near Adelaide. Twice, he and his party were forced to turn back, even though they were more than half way there. Finally, in July 1862, they reached the coast, near Darwin. They returned home exhausted and ill, to find

that the feat had in the meantime been accomplished by Burke and Wills (these, however, died on their way back).

Submarine The first successful sinking of a vessel by a submarine occurred in 1864 during the American Civil War. But the submarine did not emerge as an effective fighting vessel until the First World War (1914-18). The invention of the torpedo enabled German submarines to sink large numbers of allied ships.

The latest submarines are the most deadly warships ever built. They can remain submerged for months at a time. They are sometimes armed with guided missiles that can be fired from beneath the water at targets 2,000 miles or more away. And they can travel at more or less the same speed as surface ships.

The superiority of modern submarines over earlier models comes from their engines, which are powered by nuclear reactors. (See Nuclear energy.) These engines need no air to operate.

Earlier conventional submarine engines are powered under water by batteries. The batteries are kept charged by diesel engines. But, since diesel engines need air to work, the submarine must surface periodically. And when it does so it is vulnerable to attack.

However, all submarines work on the same principle. They have a number of *ballast tanks* which can be filled with water to make them dive and emptied again to bring them back to the surface.

Submarines are steered by a rudder and movable fins, or *diving planes*, at the stern (rear) and two similar planes at the bows (front). Navigating under water is difficult. There are no landmarks or stars to help the navigator check his position. He can only do that by surfacing. The latest submarines have a complicated *inertial navigation system*, which involves gyroscopes and computers.

When manoeuvring towards a prospective surface target, the captain orders the submarine to 'periscope depth'. At this

The U.S.S. *Nautilus*, which was the first submarine to be powered by a nuclear reactor, among ice.

depth the submarine is just below the surface. But its periscope, which rises from the vessel's conning tower, projects just above the surface. The captain can then manoeuvre the vessel to fire his torpedoes at the target.

Sudan in north-eastern Africa, is the continent's largest country. It has an area of 967,500 square miles. Desert covers most of the northern part of the Sudan. In the central region are plains. And the south has tropical forests. The river Nile provides much-needed irrigation. Its two branches, the White and Blue Nile, join at Khartoum, the capital of the country.

The Sudan's population of 15,800,000 is divided into two main groups. About two-thirds of the people are Arabs and Nubians who live in the north. The Arabs are Muslims. The remaining third are tribal people who live in the south. Agriculture is the main occupation.

In the 1800's the Egyptians seized the Sudan. Britain and Egypt ruled jointly from the late 1800's. In 1956 the Sudan became an independent republic.

Suez Canal The Suez Canal links the Mediterranean and Red Seas across the Isthmus of Suez. It runs for about 100 miles between Suez in the south and Port Said in the north. It is one of the world's great seaways, reducing the distance between Europe and the Far East by thousands of miles.

Unlike most canals, the Suez Canal has no locks, because there is little difference in levels between the two seas it links. Ships travel through the Canal in convoy. The passage takes about fifteen hours. The Canal must be continually dredged to prevent the desert sand from blocking it.

The Ancient Egyptians were the first to build a canal across the Isthmus of Suez, possibly as early as 1000 B.C. They cut a channel from one of the tributaries of the Nile to the Bitter Lakes, which were then part of the Red Sea.

A location map of the Sudan.

The present canal route does not touch the Nile but strikes directly north-south through Lake Timsah and the Bitter Lakes, which are now some way from the Red Sea. Ferdinand de Lesseps, a French diplomat and engineer, took 10 years to build the present canal. It was opened in 1869.

The canal was controlled by the Suez Canal Company until 1956, when Egypt seized control. It has twice been closed as a result of Arab-Israeli wars, in 1956 and since 1967.

Suffolk (area 1,480 square miles), a maritime county of eastern England, was divided for administrative purposes into East Suffolk (capital Ipswich), and West Suffolk (capital Bury St Edmunds). Its county town is Ipswich, and its population is 545,000.

Most of the county is low-lying, although there are chalk hills in the south-west. The North Sea coastline is flat and often marshy. In the north, the Waveney and Little Ouse rivers separate the county from Norfolk, although part of the Broads, traditionally associated with Norfolk, lies in Suffolk.

Suffolk is largely agricultural—sugar beet, barley and wheat being the main crops. Industry includes the manufacture of fertilizers and farm implements. The county was once noted for the breeding of sturdy horses known as Suffolk Punches.

The headquarters of English horse racing are at Newmarket. Aldeburgh, which is famous for its annual musical festival, is on the east coast of the county.

Above: Sugar beet is grown in temperate regions. The sugar is extracted by slicing the roots and boiling the slices to remove the sugar juice.

Left: Sugar cane grows in tropical countries. The juice is simply extracted by shredding and squeezing the stems in machines.

Sugar is a substance we use to sweeten food. This sugar is called *sucrose* by chemists. There are several other kinds of sugars, including *glucose*. The body needs sugars and starch to make glucose, which it uses to produce energy. But although sugar is essential to health in this way, many people eat more sugar than they need. This excess sugar increases tooth decay and causes fatness.

All plants produce sugars and starch by *photosynthesis* (see Photosynthesis). The sugar cane and sugar beet plants make sucrose in large amounts. Sugar cane resembles bamboo plants and grows in tropical countries. The stems contain a juice that is rich in sugar. Sugar beet grows in temperate countries, and the roots contain sugar. The world's leading sugar-producing countries are Russia, Cuba, the United States, Brazil and India.

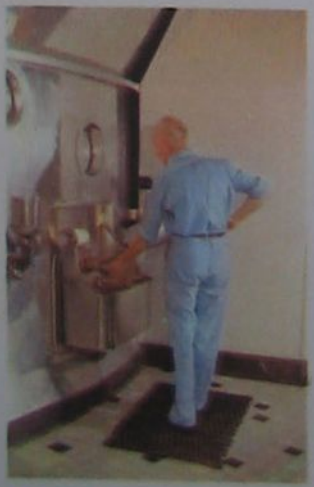
Other kinds of sugar can be obtained from the sap of the maple tree; from milk,

1

Sugar cane (1) is the major source of sugar. The cut canes are loaded onto a lorry with a crane in Trinidad (2). At the refinery, the sugar juice is extracted and purified to make sugar. Samples are taken at various stages in the refining to check quality (3). The pure sugar may then be transported in bulk by road or rail (4), and packed into forms suitable for sale (5).

2

3



4

5

as a by-product of cheese-making; and from corn-flour.

In sugar refining, sugar juice must first be obtained from the cane or the beet. The processing is then the same whatever its source. Cane juice is obtained by shredding and squeezing the stems in machines. This action forces out the juice from the canes. Sugar beet is first sliced and then placed in hot water to remove the juice. The sugar juice contains raw sugar. The juice is heated, and, as the water evaporates, it thickens to a syrup. Sugar crystals and molasses form in the syrup and are removed. The sugar crystals are brown at this stage, and may be decolourized with carbon powder to produce white sugar.

Sukarno, Achmed (1901-1970), was the first president of Indonesia after it became independent of Dutch colonial rule. He was born in Surabaja, Java, and studied engineering in Indonesia. In 1927 he organized a radical nationalist group whose aim was to overthrow the Dutch. The Dutch jailed him twice and then exiled him on a small island. He was released when Japan occupied Indonesia during World War II.

After the war ended in 1945, Sukarno and another nationalist leader, Mohammad Hatta, declared Indonesia independent, naming Sukarno as president. The Dutch, however, refused to recognize this, and war broke out. The fighting continued until 1949 when the Netherlands yielded.

Free of the Dutch, Indonesia still faced years of political conflicts and rebellions. Sukarno assumed increasingly more power, until by 1960, he had become a dictator. In 1966, after an attempted *coup* (revolt) by the Communist Party, Sukarno lost power to General Suharto but he kept the title of president until the following year, when he was deposed.

During his time in office, Sukarno unsuccessfully opposed the inclusion of Sabah in the Federation of Malaysia. In 1965, he took his country out of the United Nations and tried to establish a separate organization of new nations, of which he would be a leader.

Sulphur is one of the few chemical elements that can be found *native*, or uncombined with other elements in Nature. It is a pale yellow in colour and melts and burns easily. When it burns, it gives off choking fumes of sulphur dioxide.

Most sulphur is made into sulphuric acid, which is the most important of all industrial chemicals. The largest use of the acid is in the production of fertilizers, such as ammonium sulphate. Vast quantities are used in metal refining, electroplating, and making rayon.

By itself, sulphur is used for hardening, or *vulcanizing*, rubber for tyres. It is also used in making gunpowder, matches and insecticide sprays. The paper industry consumes large amounts of sulphur dioxide for making pulp.

Native sulphur is the most valuable source of the element. It is usually found near volcanoes, which give off sulphurous gases. But ores in which sulphur is combined with metals, such as pyrites (iron sulphide), and galena (lead sulphide), are also important sources.

In the United States—the world's largest producer—native sulphur is mined underground by an ingenious method. It is melted by steam and then pumped while molten to the surface.

An offshore sulphur mine in Louisiana, U.S.A.; the sulphur is heated by steam and pumped up while molten

Sulphuric acid (H_2SO_4) is probably the most widely used of all industrial chemicals. It goes into making everything from petrol, explosives and metals to dyes, drugs and fabrics. The fertilizer industry is the biggest user. Sulphuric acid is a clear, colourless, oily liquid. In concentrated form, it is highly *corrosive* (it eats away) and is very harmful to the skin. The acid conducts electricity. When mixed with water it releases a great deal of heat. It also draws water out of other substances, which is why it is used as a drying agent.

Sumatra is the second largest island in Indonesia. It lies south-west of Malaya, north-west of Java, and west of Borneo. With its off-shore islands, Sumatra covers an area of 183,000 square miles. The Equator cuts directly across the centre of the islands. The climate is hot and wet throughout the year. High volcanic mountains extend all the way down the western side of the island. These drop sharply to the Indian Ocean in the west, but in the east slope gradually to a partly swampy plain. Dense tropical rain forests, inhabited by rhinoceros, leopards, elephants and other wild animals, cover much of the interior.

Sumatra's population is about 16 million, consisting largely of village-dwelling Malay tribes. Many Sumatrans cultivate rice for food. Others work on large estates where export crops, such as rubber, tobacco, tea, coffee, sisal and pepper are grown. Minerals, including bauxite, tin, and coal, add much to the economy. Sumatra's products are shipped from ports in or near the main cities—Medan, Palembang and Padang.

From the 600's A.D., Hindu kings ruled the area. The island drew many traders on the route between China and India. By the 1200's Arabs had extended their influence and introduced the Muslim religion. The Portuguese were the first Europeans to arrive. The Dutch East India Company took over the area in the early 1600's. Indonesia became officially independent in 1949.

Sumeria was the land between the Euphrates and the Tigris rivers. Regular floods made the soil fertile and many people lived here. Between 4000 and 3000 B.C. towns were built, making one of the first two civilizations in human history in which there were many towns. Chief among Sumerian towns were Ur, Lagash and Uruk. A temple was at the centre of each town. A secret society of priests controlled each town for its god, organizing trade, keeping accounts, and recording events. The Sumerians were the inventors of the first system of writing. This is called *cuneiform.* Like the ancient Egyptian hieroglyphics, it developed from picture writing. (See Alphabet.) It was used from about 3300 B.C. to 75 A.D. and was adopted by other civilizations after Sumeria had fallen.

Ur became the chief town about 2600 B.C. but about 2400 B.C. Lagash conquered Ur. Civil war between cities continued until Sargon of Akkad, a Semite, united Sumeria in the twenty-third century. He founded an empire which stretched from the 'cedar forest' (Lebanon) to the 'silver mountains' (Taurus) to the 'mountains of the lower sea' (Persian Gulf). By 2000 B.C. this empire had collapsed under barbarian attacks from the north. (See Babylon.)

A Sumerian gaming board from the Royal Cemetery, Ur. The board dates from about 2600 B.C.

Sun The Sun is a star. It is the star round which the Earth and other planets revolve. Compared with the millions of other stars we know about, the Sun is small and of only average brightness. But because it is much nearer than any other star it appears larger and brighter.

The Sun is a mass of hot gases, more than a million times as large as the Earth and over 300,000 times as heavy. It is about 93 million miles away. Light from it takes about 8½ minutes to reach Earth. Light from the next nearest star (Proxima Centauri) takes more than 4 years.

Without the Sun, life as we know it would be impossible. It is practically our only source of light and heat.

The Sun's heat and light is produced, as in any other star, when hydrogen atoms inside it join together to form atoms of helium (see Stars). Eventually, in millions of year's time, the Sun will have used up all its hydrogen. Astronomers believe that before then the Sun will swell until it becomes a vast red star larger than the Earth's orbit.

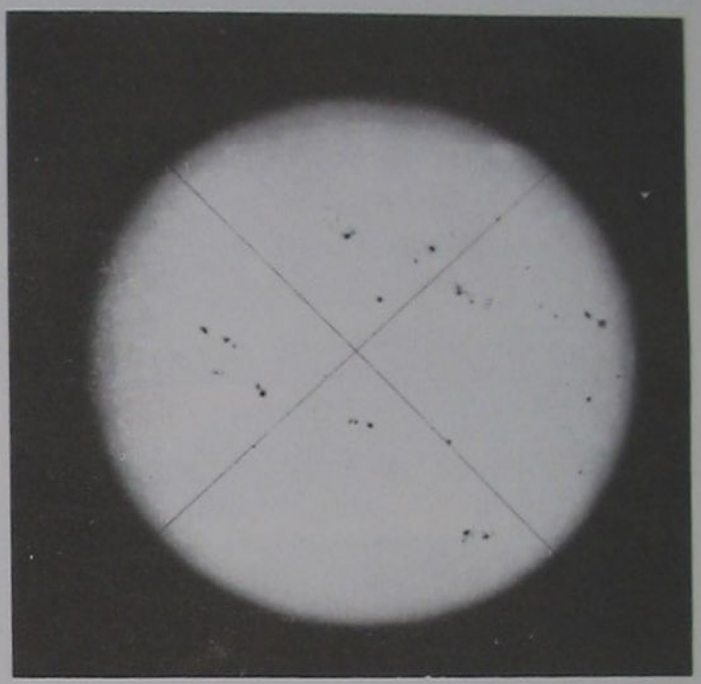
The temperature at the Sun's centre has been estimated to be about 20 million degrees Centigrade. At its surface, the temperature is 6,000° C.

The visible surface of the Sun is called the *photosphere*. It is surrounded by a layer of crimson gas, called the *chromosphere*, which can be seen only during a total eclipse of the Sun. Outside the chromosphere is the *corona*, a pearly-white cloud of very thin gas surrounding the Sun, more than a million miles deep. This, too, can be seen only during a total eclipse or with a very special kind of telescope.

From time to time, great masses of glowing gas, called *prominences*, leap great distances out into space from the Sun's surface. They are believed to be connected with the sunspots often to be seen on the photosphere.

The Sun rotates on its axis, but as it is not a solid body the time for a complete revolution is less at the equator (about 25 days) than at the poles (about 34 days).

Sunspots From time to time dark patches called *sunspots* appear on the Sun. They often occur in groups, and are areas where the surface is cooler than elsewhere: about 4,000° C instead of 6,000° C. Some measure as much as 50,000 miles across and can be seen with the unaided eye.



Above: The Sun's disc is not always smooth and featureless. In 1947, at the height of the sunspot cycle, several groups of sunspots appeared. Below: A close-up view of a group of sunspots. The spots are regions of cooler gas that are less bright than surrounding areas.

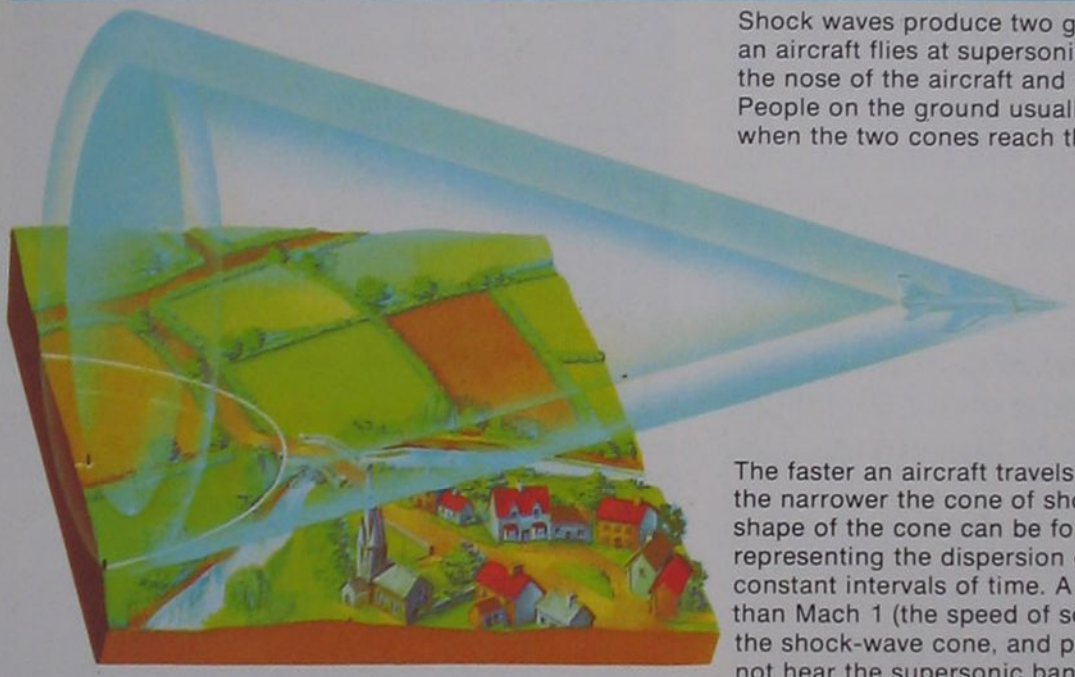
(Smoked glass *must* be used when looking directly at the Sun. Do *not* use a telescope, which is dangerous.) Sunspots have a dark central part, the *umbra*, surrounded by a lighter part, the *penumbra*.

About every eleven years, sunspots are very common, and there may be many groups visible at the same time. Following such a peak year (called *sunspot maximum*), sunspots appear less and less frequently, until at *sunspot minimum*, about six years later, the Sun may be entirely free from them for several days at a time. Then their numbers increase until the next maximum.

Particles of atoms shot out of sunspots may approach the Earth, and can cause interference to radio transmissions. They sometimes produce displays of polar lights (*aurorae*) in the upper atmosphere. (See Aurora.)

Sun Yat-sen (1866-1925) is a hero of China. He led the revolution of 1911 which overthrew the Manchu *dynasty* (family of ruling emperors). Sun staged an unsuccessful revolution in 1895. He fled from China, travelling widely to gain money and support for his Revolutionary Alliance. He was still out of the country when the revolution took place.

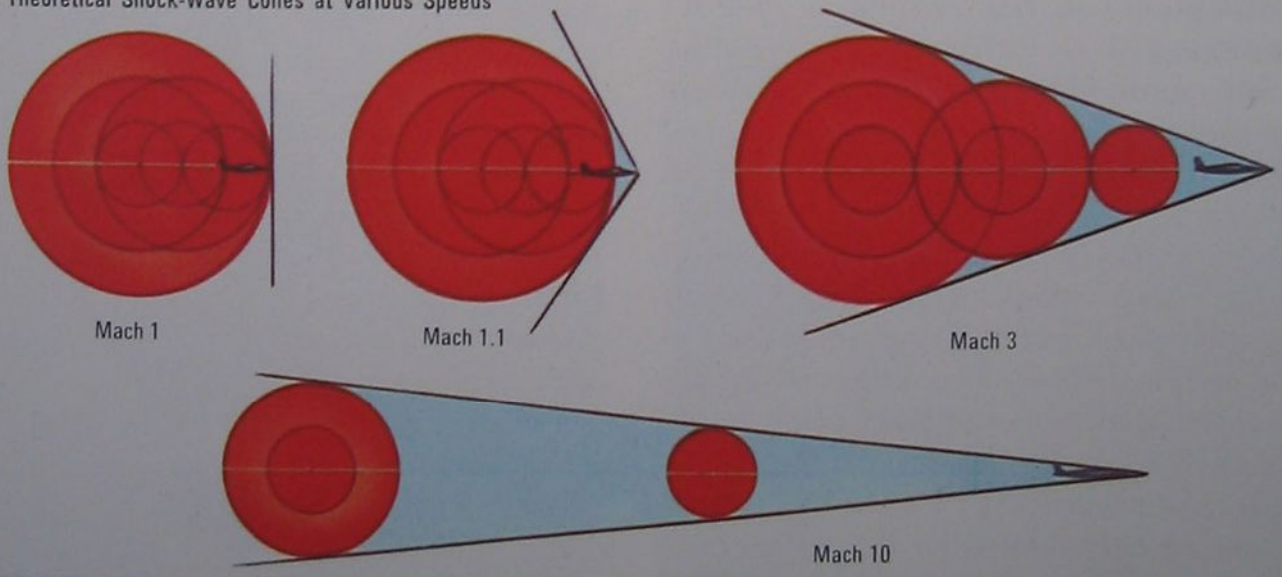
Sun returned home as president of the new government, but soon stepped down in favour of Yüan Shih-k'ai—who later

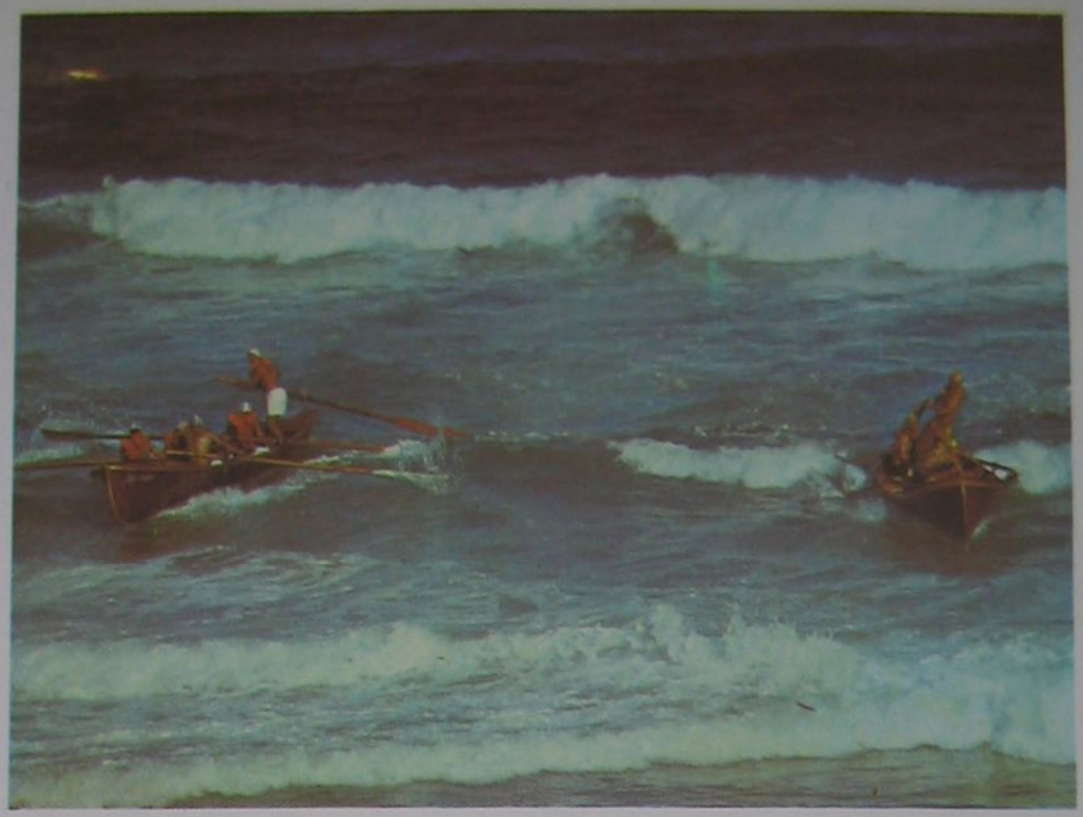


Shock waves produce two great cones in the air when an aircraft flies at supersonic speed. One cone forms at the nose of the aircraft and another at the tail. People on the ground usually hear a double bang when the two cones reach them.

The faster an aircraft travels above the speed of sound, the narrower the cone of shock waves formed. The shape of the cone can be found by drawing circles representing the dispersion of the shock wave at constant intervals of time. A plane travelling faster than Mach 1 (the speed of sound) travels ahead of the shock-wave cone, and passengers in the plane do not hear the supersonic bang.

Theoretical Shock-Wave Cones at Various Speeds





The exhilaration of riding a fast moving wave has helped make surfing one of the most popular sports in some countries. Surf-riding can be done on surf-boards, surf-skis and in surf-boats.

became a dictator. Sun formed a political party, called the *Kuomintang*, which tried unsuccessfully to overthrow Yüan. In 1921, the Kuomintang set up a republic in the south (with Sun as president and Chiang Kai-shek his military aide). With the help of the communists, Sun's government fought to unite the country by defeating the war lords who ruled the north. Sun died during this struggle.

Supersonic flight Sound waves travel through the air at sea-level at about 760 miles an hour (see Sound). Anything that moves faster than sound, such as a bullet, an aircraft, or a rocket, is said to be travelling at *supersonic* speed—from two Latin words meaning 'above sound'.

The speed of sound gets slower the higher aircraft fly. Over 36,000 feet, it is only about 660 miles an hour. Scientists call the speed of sound *Mach 1*. Twice the speed of sound is Mach 2.

When an aircraft flies through the air, it creates a wave of disturbance in the air. This wave moves at the speed of sound in all directions. At supersonic speed, the air ahead of the plane is not disturbed until the plane arrives. A shock wave is formed that we hear as a bang, called the *sonic boom*.

Surfing, or riding waves, is an exciting water sport which has gained tremendous popularity in the United States, Australia and elsewhere. There are two main ways to surf. For *body surfing*, no equipment is needed. The surfer merely swims out to meet the wave, then turns towards the shore as the wave catches him, at the same time stretching his body out to form a plane. For *surfboard riding*, a tapered board (about 4 to 6 feet long for small waves or 10 to 12 feet long for big waves) made of fibreglass or light wood, is used. The surfer, lying face down on the board, paddles with his hands until the wave catches him up. He then stands up, one foot behind the other, manoeuvring the board and trying to keep his balance. He rides the wave into the shore, keeping just ahead of the wave's crest or inside the curl.

The ancient Incas of Peru may have practised surfing, but the sport really developed in Hawaii hundreds of years ago. It spread to other countries in the early 1900's.

Surgery is a way of treating diseases or injuries by carrying out operations. A surgeon may sew up a bad cut, remove an undesirable growth from the body, even transplant a kidney or a heart from one human being to another.

The practice of surgery goes back to prehistoric times. Fossil remains show that the first operation ever attempted was *trephination,* which consists of cutting a small hole in the skull. Yet despite this early start, for many centuries surgeons could do little to relieve suffering. The main reasons for this were a lack of accurate knowledge of the human body, and a lack of any reliable way to deaden pain during an operation. Medical students were not allowed to dissect human corpses, so they were unable to learn much about internal organs.

The first man to make substantial improvements in surgery was a French doctor named Ambroise Pare, who lived from 1510 to 1590. He did away with such medieval practices as placing hot irons on a wound to stop the bleeding, and treating gunshot wounds with boiling oil. In Pare's time, many important discoveries were made. Human dissection became customary in European medical schools, and thus doctors were better prepared to perform operations.

The problem of pain, however, still confounded surgeons. Not until 1846, when ether was used at the Massachusetts General Hospital, did painless surgery begin to develop. Ether was the first anaesthetic in medicine.

Surgery was on its way. Many different operations could now be tried. Yet the success rate remained generally low. This was because no care was taken to keep either doctor or patient clean. Germs from the air and from the doctor's hands infected open wounds. Often the infection ended in death. In 1865, Joseph Lister, a British surgeon, used carbolic acid to kill germs when he operated. He also insisted on absolute cleanliness in the operating theatre. This *antiseptic* surgery greatly reduced the number of deaths caused by infection.

Today, surgery is painless and germs are prevented from reaching the patient during an operation. The operating *theatre* is germ free and the instruments and clothes of the surgeons and nurses are carefully sterilized before the operation takes place. This is known as *aseptic* surgery.

Surgery was not always the safe, scientific procedure that it is today. Left: An old print shows an operation for a mastoid in 1524. Right: Compare this with the operating theatre at the Western General Hospital in Edinburgh, Scotland.